Electrical Review

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THE NEW YEAR NUMBER.

We call attention with considerable satisfaction to this issue of the ELECTRICAL REVIEW. We think that a glance through its pages will show that we have fully lived up to our promises. Our readers will note with interest the distinguished names of the authors of many of the articles contained in this issue.

We also call attention to the new dress in which the ELECTRICAL REVIEW appears, and we believe that this will meet with the approbation of subscribers.

One of our technical exchanges gives a graphic account of the test of the new elevator in the Philadelphia city hall. This was allowed to fall over four hundred feet, and it was stated that this distance was covered in less than two seconds. We have a dim recollection that our physics taught us a body would fall in vacuo sixty-four feet in two seconds, and up to this time we have not been able to explain the record established by this elevator, unless perhaps its speed was measured in Philadelphia time as usually reckoned by the non-resident!

A MORSE DIARY.

On another page of this issue will be found a description of a hitherto unnoticed diary kept by Samuel F. B. Morse during his early work on the Baltimore-Washington telegraph. The book contains copies of letters written and received by Morse on business connected with the construction and laying of the cable which, as is well known, was unsuccessful. This, however, does not detract from the interest with which one follows the work of this first attempt to construct a practical telegraph.

The journal starts with an entry made nearly sixty years ago. This is dated March 14, 1843, and is a copy of a letter from J. C. Spencer, Secretary of the Treasury, giving explicit instructions as to the handling of the appropriations made by Congress for this experiment. Many of the letters give an idea of the troubles and difficulties which beset this experiment, as well as the resourceful spirit with which Morse went to work. He never seemed to lose heart, and was never at a loss to overcome the failures of others.

The cable, as described, consisted of four copper wires, each covered with cotton twine and with two coatings of shellac. These were to be bound together by another layer of cotton, and then covered by a sheathing of lead. Morse describes in his letters his invention for introducing the wires into the pipe as it was made, by means of a hollow mandrel, through which the cotton-covered wires were passed. This cable contained one hundred and sixty miles of copper wire, giving four lines between Washington and Baltimore. The letters indicate that it was intended to use these in pairs, making two complete metallic circuits. The cotton twine for each wire had a distinctive color, so that any wire could be identified at intermediate points. Later entries show some modification of the construction of this cable, and much of the cotton twine was made unnecessary, the wires being covered with colored shellac.

In some of the entries Morse shows a pardonable pride in reducing the cost of this "experiment with the electromagnetic telegraph."

Under the date of August 10, 1843, are described tests made with the wire before covering it with the lead sheathing. Three hundred batteries had been prepared for operating the cable, but it was found that one hundred of these were sufficient to produce the desired effects through the whole one hundred and sixty miles of wire. The following entry is interesting: "Some careful experiments on the decomposing power at various distances were made, from which the law of propulsion has been deduced, verifying the results of Ohm and those which I made during the summer of 1842."

The paragraph following the one we have just quoted is probably the most striking in the book, containing as it does this prophesy: "The practical inference from this law is that a telegraphic communication on my plan may, with certainty, be established across the Atlantic. Startling as this may seem now, the time will come when this project will be realized."

How well this prophesy has been fulfilled! To-day there is no ocean unspanned by a telegraph cable.

This old record of the first work in telegraphy takes added interest from our latest accomplishments. We have completed the first Pacific cable and have made a good start on the second; and Marconi has established communication across the Atlantic without wires. It is difficult to realize that this diary was written less than sixty years ago.

Who will venture to predict the electrical developments of the next sixty years!

THE PACIFIC CABLE.

The successful laying of the first section of the American Pacific cable, which was completed on the first day of the year, was a very important event. This undertaking was largely due to the late John W. Mackay, and it is much to be regretted that this distinguished Postal-Telegraph official did not live to see the fruition of his labors.

Aside from its commercial and military value, the cable can not but have a beneficial effect upon the relations between this country and its new dependencies. We are informed that the remaining sections will in all probability be in operation by the Fourth of July, putting us in close communication with the Philippines.

We commend the energy with which this work has been carried on by Mr. John W. Mackay's son, Mr. Clarence H. Mackay, upon whom the mantle of responsibility in the field has fallen, as well as that of his able associates, Mr. G. G. Ward and others.

ELECTRIC LIGHTING FOR RAILWAY TRAINS.

The current issue of *Insurance Engineering* briefly discusses the advantages of electric train lighting.

The features claimed for this system are that electric lighting is more convenient and gives a more satisfactory illumination; the air of the cars is not vitiated, and the lights are not affected by draughts. The general control of illumination which can be given to the lighting of the whole train is an important feature. The chief objection to all these systems is the cost. It is stated that figures obtained from trains operated on the Prussian railways, which are using steam turbines mounted on the locomotive, show that the cost of lighting is increased three times by the use of electricity over that for gas; but that these turbines are not as efficient as they should be.

While it is not to be expected that the advantages of electric lighting can be obtained at a lower figure, or even at the same figure as gas lighting, the increased cost should not prevent railway managers from introducing this modern system of illumination. They spare no expense in fitting up their cars with other conveniences, but still adhere to old methods of illumination in nearly all cases.

WORLD'S FAIR—1904.

We note with satisfaction that persons who have recently visited St. Louis and the site of the exposition grounds are uniformly enthusiastic in praise of what the management has planned and thus far accomplished.

In matters affecting the electrical field the progress seems to be especially encouraging. The Palace of Electricity is already nearing completion and presents an appearance fully up to the standard of architectural beauty claimed for it. In fact, report has it that it will be the handsomest structure on the exposition grounds.

The Department of Electricity is receiving hearty support from the manufacturers of electrical machinery and appliances. This is largely due to the confidence awakened by the clear and convincing statements which emanate from the department, and to the belief that is growing in the stability of the management of the fair.

It must be acknowledged that the conditions under which manufacturers are given the right to exhibit their products are most liberal and equitable. They are apparently made with the view of conserving the economies and thus encouraging exhibitors to put their best efforts into their exhibits.

The forecast of the electrical illumination of the grounds and buildings presents many fascinating possibilities. The opportunity is certainly ripe for a most gratifying realization of another dream of light and beauty. The people of America have been most liberally educated in matters of illumination during the past ten years, and are but naturally expecting great things. The combinations of color lighting, amid and surrounding the cascades, that are planned, possess great possibilities.

Advices from abroad indicate a keen interest on the part of the engineers of Europe, and it is not too much to expect that the foreign exhibits shown, as well as the foreign engineers in attendance upon the exposition, will be among its great attractions. The electrical engineers of America should not be backward in making the most of the opportunity that is offered to meet again under most favorable circumstances their professional brothers of the old world.

ELECTRICITY FROM THE HEAVENS ABOVE.

We have been asked to comment on the announcement recently made in the daily press that a man has invented a method of drawing electricity from the outer ether in unlimited quantities.

The apparatus by which this wonderful feat is to be performed consists merely of a metallic cable stretching upward a distance of two hundred and seventy-five miles. The cable is made up of several sections of different materials, but the reasons for this construction are not given. The following sentence gives the inventor's explanation of how this cable is to be kept in its position, as given in a Chicago paper: "A mass of matter moving through interplanetary ether, elongated one thousand times the length of its diameter, always moves on a path coincident with its path of elongation, and the weight of such mass is always around the elongated centres at right angles to its path of motion and elongation."

We have tried to grasp the meaning of this statement, but have not succeeded. The newspapers, however, explain that the discoverer asserts that after a body reaches a certain height above the earth the action of gravity is reversed and acts outwardly, so that after projecting this cable to a certain height it will be necessary to hold it down rather than to hold it up.

To the ordinary technical mind these statements have no meaning. When we learned our physics we were taught that the moon was kept from flying off into space by the attraction of the earth, and was only retained in its position by the centrifugal force due to its velocity in its passage around the earth. It would be a simple matter, were it worth the trouble, to calculate the height and the velocity with which a body would have to be projected to enable it to retain a position above the earth. Most of us doubtless have read Jules Verne's story of the brick moon, where this idea is worked out.

It is unnecessary for us to express an opinion of this ridiculous scheme for milking the ether of the electricity with which it is assumed to be saturated. No doubt this story will be widely circulated and read with interest throughout a large part of the world, and will be forgotten within a week, as such absurdities should be.

A Review of the Year.

By Wm. Hand Browne, Jr.

THE past twelve months have been marked more as showing the great progress in the industrial applications of electricity, rather than improvements in the arts. Reports from all sections of the country show a large increase in nearly all lines of work. Much capital has been invested, and electrical manufacturing concerns have been loaded down with orders. This happy condition unfortunately was not true of all countries. The over-development of Germany in the past few years caused a great deal of stagnation during the past year. In England matters were considerably better, but there was still a great contrast between that country and the United States.

THE TELEGRAPH.

Considering first the earliest application —that of the telegraph—reports from the companies show largely increased business. This fact is clearly brought out by the typical case of the Western Union Telegraph Company. The figures for the last six months are not available, but the report for the year ending June, 1902, shows that nearly 60,000 miles of wire were added to the system during the year. The number of messages transmitted was increased by nearly 4,000,000, not including messages over private lines. The total increase in the profits was in the neighborhood of $1,750,000. It is noticeable that of the newly constructed wires over 28,000 were of copper, indicating that better construction of lines is receiving full attention.

The death of Mr. John W. Mackay, president of the Postal Telegraph-Cable Company, which occurred on July 20 last, was a severe loss to telegraph interests.

Comparatively little progress has been made in the commercial application of rapid-machine telegraphy, certain companies still holding that these systems should serve merely as adjuncts to the manual transmission, and can not replace the operator. However, the Postal Telegraph-Cable Company, with commendable enterprise, has given a great deal of attention to the Murray apparatus with good prospects of soon having it in shape for commercial use. The Rowland page-printing system has been thoroughly tested and has been adopted by the German Government.

THE OCEAN CABLE.

Two notable events in marine telegraphy took place during the latter part of the year. The first was the completion of the British Pacific cable by the laying of the section from Vancouver to Australia. On November 1 Mr. Charles J. Glidden sent the first message around the world. This was started from Boston and reached the same point thirty-nine hours and twenty minutes later. The second event touches us more closely. On December 12 the steamer Silvertown left San Francisco for Honolulu with the first section of the cable which is being laid by the Commercial Pacific Cable Company. The trip was made without accident and the vessel reached her destination on December 26. Due to stormy weather, she was unable to connect with the shore end for several days, so that the final act in this undertaking was not completed until the evening of January 1, when communication was established with San Francisco. The event, however, belongs distinctly to the year 1902.

WIRELESS TELEGRAPHY.

Wireless telegraphy, to which the public is accustomed to turn when pointing out the marvelous developments of science and engineering, has made great strides and still holds a foremost place in the popular mind. It was only a year ago last December that Mr. Marconi first transmitted a signal across the Atlantic. The message was simply a repetition of the letter "S". On February 25, while on board the steamer Philadelphia, a distance of over 1,500 miles from Poldhu, an intelligible message was received. During the summer the King of Italy put the cruiser Carlo Alberto at the disposal of Mr. Marconi, and very successful experiments were carried out between the vessel and the Poldhu station, messages being received over a distance of 1,700 miles. On the twenty-first of December last Mr. Marconi announced that communication had been established between his new station at Glace Bay, Cape Breton, N. S., and Poldhu, messages being transmitted both ways in English and in Italian. This is truly a remarkable record. Other inventors have been active in this field, and Professor Reginald A. Fessenden deserves credit for developing a very complete system, embodying many new inventions and features. Mr. John Stone Stone has also been granted a number of important patents in this field. The theory of the method of propagation is, however, still in a very unsatisfactory state.

THE TELEPHONE.

Passing from the telegraph to the closely allied branch, the telephone, we see that while great strides have been made in the wider introduction and more general use of this instrument, but little change in the art has been made. All the companies, independent as well as Bell, report great prosperity, which is well illustrated by the typical example of the New York Telephone Company. During the past year over thirty thousand stations were added to this great system. The telephone is being recognized more and more as a necessity, and a noticeable feature of this expansion is the very general adoption by office buildings and hotels of a local system, putting all parts of the building in communication with the main office, and from there with the city service. The telephone is rapidly replacing all other calling systems in hotels. The noticeable engineering features are the conversion of all large cities to the common battery system and the extension of the underground lines into the distant parts of the cities. This extension of the cables has brought its difficulties. It is not generally known—but it is, nevertheless, a fact—that the limit of transmission through a cable is reached within the city of Greater New York, and the problem which is now confronting telephone engineers is the application of the Pupin system to the cable, which will considerably increase the possible distance. Experiments recently made by the Siemens & Halske Company in Germany show a possible increase under the conditions there obtaining of four times. The American Bell company is not behind in this work, but is not willing as yet to give out any figures. The Pupin system has been applied to overhead lines, with material improvement in the quality of the service.

Automatic telephone systems are presenting claims which justify a careful examination, and the system of wireless telephony which has been developed by Mr. A. Frederick Collins has been much improved in the last year.

THE ELECTRIC LIGHT.

Electric lighting has enjoyed a very successful year, though here again no startling announcements have been made. The problem of securing a better and

more efficient lamp is receiving the attention this all-important problem deserves. Probably the lamp which attracted the greatest amount of attention during the last year was the Nernst, as it has been put out and given great satisfaction. The new German arc lamp, the Bremer, was placed on the market by the British Westinghouse company and is being carefully studied in this country. The arc lamp still holds its field, but the open arc is being replaced rapidly by the enclosed type. Attempted improvements in the efficiency of arc lamps have been made by the addition of other materials in the carbons, somewhat after the manner of the Bremer lamp, but as yet the value of these can not be stated.

Electric lighting stations show but little change. The tendency is toward large direct-connected units, but the high-speed machine, driven by a steam turbine, is attracting a great deal of attention. An announcement of considerable local importance was made by the New York Edison company when it reduced the price of electrical energy twenty-five per cent.

THE ELECTRIC RAILWAY.

Electric traction held its position as the most active of all lines of electrical application. The development in this field shows a tendency toward two systems—the interurban line, built closely according to steam railway ideas and operating with few stops at fairly high peeds; the other, the trolley line extending from the city out through the suburbs, or connecting together smaller towns. These roads in many cases carry freight and express matter as well as passengers.

Early during the year the first electric train was put in service on the Manhattan elevated roads, New York city. This service has been extended as rapidly as possible. The elevated road in Berlin was opened on February 15. In Great Britain several steam roads have decided to adopt electricity for local service at several important cities. The New York Central decided upon electrical operation of its suburban lines. A contract was taken by the Westinghouse Electric and Manufacturing Company to install a single-phase alternating-current system between Baltimore and Washington, thus again attracting attention to the application of alternating currents to railway work. A mono-rail system is to be constructed between Manchester and Liverpool for high-speed service. The Ward-Leonard system is to be applied to an important Swiss railway. Although in the cases just mentioned the roads have not been completed, they serve to indicate the activity in this field of work.

Some important experiments have been conducted during the year. Mr. B. J. Arnold is developing his electro-pneumatic system, the principles of which were announced early in the year. The high-speed tests on the Berlin-Zossen track have been continued, and it is noteworthy that in part of this work the very high potential of 10,000 volts was applied directly to the driving motors. A speed of ninety miles an hour was sustained.

Other problems in railway operation have attracted the attention of engineers, particularly with reference to increasing the speed of local trains.

LONG DISTANCE TRANSMISSION.

Electrical transmission has been distinguished by a number of important events. In this work the tendency has been to increase the voltage of transmission and thus cover a larger territory. There is now a plant at Butte, Mont., operating at 80,000 volts, while plants operating at from 40,000 to 60,000 volts are not unusual. At Niagara work has been pushed on both sides of the river. The water-works of the two Canadian companies are well advanced; the first generating units of the new power-house of the Niagara Falls Power Company have been run. The Niagara Falls Hydraulic and Manufacturing Company has secured a tract of land lying to the northeast of the city, where it is intended to build up a new manufacturing centre. The magnificent power-house at Sault Ste. Marie was put in operation October 25. It is a rather striking fact that practically the whole output of this plant will be utilized on the spot. The new problems presented by the increased line voltages are attracting a great deal of attention, in the hope that improvements in construction will enable still higher voltages to be used. In a few instances steel towers have been used in place of wooden poles, these being much higher and spaced much further apart.

Plans were announced during the year for developing a number of important water powers in this country and abroad. Work in India along this line has been very noticeable.

There has been but little change in the types of electrical machinery now accepted as standards for power development. As indicated above, the tendency has been along two lines—the enormous direct-connected units and the smaller high-speed turbine-driven generator. The advantages of the latter have been generally recognized, but heretofore there was some question as to its reliability. There seems little question but that this type of generating unit will become popular. One large lighting station has already decided to adopt this system, and it will be given a trial in railway work during the coming year. The gas engine has also received a full share of attention.

The real advantages of the electric motor for driving machine tools have been realized, and this method of shop driving is becoming more and more the standard.

ELECTROCHEMICAL.

Progress in electrochemical and electrometallurgical work has been very substantial. An important event of the year was the organization of the American Electrochemical Society. This took place at Philadelphia on April 3, and the meeting was eminently successful. The second general meeting, held at Niagara Falls in September, was also productive of good results. The desire of workers in this field to get together and get the benefit of the experience of others is noteworthy. Many improvements of old methods and a number of new applications of the electric furnace were made. Steel is now being made in France in the electric furnace. This application has received attention in this country, but as yet has not been applied on a practical scale. The erection of a machine shop at Niagara Falls, in which will be constructed the apparatus to be used by the Atmospheric Products Company for the fixation of nitrogen, marks the first stage in the practical application of an old discovery. It is impossible to even touch upon all the work in this field during the past year, but a review would not be complete without some reference to storage battery developments. Although the crop of storage battery patents has not been small, but little change has been made in the lead cell. The use of the storage battery is, nevertheless, increasing, particularly in automobile service. For city work it has given great satisfaction. There has been some delay in bringing out the Edison nickel-steel battery. The inventor announces that the cell has been very decidedly improved during the past year, and has been submitted to severe practical tests, in which it has more than fulfilled his expectations. He has, however, not been willing to put the battery upon the market until these tests were conclusive. Early this year the batteries will be put in service for automobiles in New York and Brooklyn. The cell, however, can not be put upon the market in large quantities for some time, owing to difficulties in obtaining material for its manufacture.

AUTOMOBILES.

Except for city work, electric automobiles have not made marked advances. Much improvement has, however, been made in other types of machines, by which the electric will benefit later. These have resulted in greatly increasing the reliability of the machines, as was well brought out by the reliability test conducted under the auspices of the Automobile Club of America last October.

STATE LABORATORY.

The important factor which electricity has become in other industries was recognized during the year by the appointment of a committee to consider the advisability of establishing an electrical laboratory for the state of New York. After careful consideration, this committee has drawn up plans, and the laboratory seems fully assured.

TECHNICAL EDUCATION.

In closing this necessarily brief review of the year we should not fail to mention the interest which has been taken in technical education. This subject has received the attention of prominent engineers and educators, both in this country and abroad, and this will undoubtedly result in improvement. Forces seem to be working toward more uniformity in instruction and more attention to principles, leaving the more strictly engineering information to be acquired from actual practice.

A Talk With Edison.

A VISIT to the Edison laboratory at Orange, N. J., is always interesting, but it is made doubly so when the visitor is fortunate enough to find Mr. Edison there and be received cordially. Mr. Edison has not been very well of late, as he is somewhat run down by his unremitting labors at the cement works. These, however, are now in operation, but, instead of taking a much needed rest, with his characteristic energy he has turned his whole attention to the commercial development of his storage battery.

The storage battery, Mr. Edison states, is now considerably improved over what it was when the first description was given by Dr. Kennelly. Many improvements have been made, particularly for making a mechanically stronger plate and in preventing any electrolyte from being sprayed out of the cell under the most severe conditions of operation. The capacity of the battery has been greatly increased, but Mr. Edison was not willing for it to be put on the market until it had been subjected to severe practical tests. These tests have been carried out under the most trying conditions for many months, and have resulted in the improvements mentioned above.

Edison Storage Battery.

A number of firms in New York adopted these batteries for their delivery wagons on the first of the year, and expect to double the distances formerly covered by their wagons. Difficulties in securing the particular steel and nickel desired prevented their being placed upon the market earlier.

It has been found necessary to import steel plate from Germany, as it could not be secured from the steel companies here of satisfactory quality and thinness. An arrangement has been made with a large establishment which will install a rolling plant at its factory for furnishing steel for the batteries.

Mr. Edison expressed his admiration for Mr. Marconi. "He is one of the men who does things," he said. Marconi had telegraphed him of the success of the work at Cape Breton. Mr. Edison replied by telegraph, congratulating the distinguished Italian upon his notable achievements.

Marconi.

In answer to a question as to the trend of electrical matters which might be looked for in the future, Mr. Edison said that although seeing by electricity could not be considered impossible, he did not think this would be of "any practical value."

Seeing by Electricity.

He was very much interested in the developments going on in applying alternating currents to railway work, but thought that the question had narrowed down to simply one of investment, as the alternating-current motors were not better suited for traction work than the series motors. The advantage gained through the use of alternating currents would then be simply a saving of copper.

Alternating Currents in Railway Work.

Answering a question if we might expect to produce electricity directly from fuel, Mr. Edison said he thought we would, and that he was working on that problem himself from time to time.

Electricity Direct from Fuel.

"But it is a hard proposition, and a satisfactory method probably will not be found for some time to come," remarked the veteran inventor.

Mr. Edison expects to start from here early in February and take a much-needed rest at his Florida home, where he will possibly spend a month or so. He is anxious, however, to get back and take up some scientific work, for which he has been preparing for two years. He now has a laboratory thoroughly equipped with new special apparatus for these researches, and with characteristic impatience is looking forward to the time when he can plunge in and do something in this direction. Just what, he did not state. Until that time, however, his undivided attention will be devoted to developments and study of his storage battery. This is now, as stated above, in a highly satisfactory state electrically, and beautifully worked out in its mechanical details.

Experimenting in New Fields.

Although Mr. Edison said he was feeling the need of a rest, his eyes are as bright as ever, and nothing seems to affect his buoyant good humor. He described with considerable pleasure a number of incidents which happened to him—his experience with a reckless automobile driver, and his failure to invent a satisfactory scientific meal. The only material which had proved of value was hydrogen peroxide, which he stated was all right.

Where Science Failed.

Electrical Theories.

By Dr. John Trowbridge.

THE reader of *Science Abstracts* for the year 1902 is impressed with the prominence given to ion and electron theories. Rœntgen's discovery of the X-ray went further than exhibiting the human skeleton; it may be said to have led the way to an anatomy of the atom.

Maxwell's electrodynamic theory treated of to and fro motions in the ether, but it did not take account of the excursions of corpuscles animated, so to speak, by electricity and endowed with velocities approaching that of light. The discovery of the X-rays compelled attention to the vibration of atoms; and investigators having concluded that there were corpuscles shot off from electrodes, tried to reconcile the emanation of light from surfaces struck by these minute particles with Maxwell's theory. It seemed possible to suppose that when such particles encountered a surface they caused electrodynamic ripples in the ether which gave the sensation of light.

It is noticeable that more attention has been paid during the past year to the flying corpuscle than to the ripple it is supposed to cause in the ether. There have been numberless articles on the electron and on the motion of ions. Electrochemistry has, therefore, become a leading subject in electricity. One perceives in such foreign journals as the *Beiblatter* to the *Annalen der Physik* a comparatively new section devoted to physical chemistry—five years ago it was a very small section, now it is the most voluminous one. Physical chemistry is largely, at present, electrochemistry. The best authorities regard the electron and ion theories only as provisional helps to our understanding. The electrical current can be explained by the motion of electrons between the atoms, but large assumptions have to be made and the work of the past year can not be said to have advanced our knowledge of the *modus operandi* of the passage of electricity through metals.

More work on the ion theories has been done at Cambridge, England, than else-

where. Professor Thomson has a body of enthusiastic students engaged in studies of radioactive bodies which are destined to enlarge our knowledge of the minute structure of the atom, and, consequently, of its reaction to the electrical stimulus. Professor Rutherford has also made an exhaustive study of radium and thorium, and has come to the conclusion that the peculiar X-ray light and the remarkable power of dissipating electrical charges is due to a slow chemical change, so slow that it seems to put radioactive effects in the class of argon, when we consider the comparative chemical inertness of this gas.

The connection of electricity with radioactive effects has been shown in a striking manner by Elster and Geitel, who have discovered that a wire suspended above the earth and negatively charged becomes radioactive. Indeed the radioactive material can be scraped off the wire and renders all substances it comes in contact with radioactive. Professor Thomson has studied this phenomenon and finds that air or gases bubble, though water becomes radioactive.

We start out on a new year with a greatly increased number of facts in regard to the effect of electricity on the ultimate particles of matter. The chemist's atom is evidently much more complicated in structure than we had supposed, and the question arises, Is not the ether—Maxwell's electrodynamic medium—also highly complicated?

One would suppose that spectrum analyses would be a great aid in studying the structure of atoms through the vibrations communicated to them by electromotive force. The method is so infinitely delicate that we have much to expect from it; its extreme delicacy, however, is almost a bar to expect finite solutions by its aid. My own experiments, with probably greater and more varied electromotive forces than have been used by other investigators, lead me to believe that electricity effects its passage primarily through gases by an electrolysis of water vapor. I am persuaded that pure hydrogen is an insulator. With a high voltage and a large condenser capacity I find the disruptive discharge in gases a most interesting phenomenon. A considerable interval of time must be allowed between successive disruptive discharges to allow the gas to recover its electric strength. This phenomenon shows that there must be a limit to speed in all methods of spark telegraphy.

Wireless telegraphy keeps Maxwell's electrodynamic theory before us, and prevents our losing sight of fundamental principles in the multiplicity of electron and ion theories. Recent authorities differ in regard to the method of transmission of Marconi's signals. Some firmly believe that Hertz waves are transmitted through the ether of space. Others point out the infinitesimal height of the tallest pole which can be practically erected in comparison with distances of over a thousand miles. The height of such a pole could not be represented on any reasonably sized diagram. The question is asked, Does not the earth act in its condenser capacity, and is not the transmission due to an isochronous fluctuation of electrical charges? The theory of transmission must certainly take into account the capacity of the earth, together with the self-induction of the sending and receiving apparatus.

The work of the year, both in the direction of electrochemistry and in the practical application of Maxwell's electrodynamic waves, will undoubtedly lead to new developments in wireless telegraphy.

Electric Traction in 1902.

By Dr. Louis Bell.

FROM a purely statistical standpoint, electric traction has rounded out the year just past by a measure of growth sufficient to satisfy the most exacting enthusiast. But the number of miles of track built, the capacity of stations installed, the hundreds of cars put into operation, all these are less significant in the progress of the art than the advances in methods and in apparatus, the relation of the roads to the great transportation system of the country, and their added importance to the life of the people. Our electric railroad is not like a sawmill or a shoe factory—a purely private enterprise to be judged by its balance sheet, but it is a very vital factor in the welfare of the community and can not shake off its responsibility to that community.

Electric railway building in 1902 has been made up of three distinct classes of work. In the first place, there has been the full normal growth of urban and suburban street railways. Extensions of such sort come as part of the regular course of events, are of great public utility, add materially to the earning powers of their respective systems, but do not tend to advance the art. The only way in which they differ from the extensions of former years is in an increasing tendency to lay better and solider track and to run larger and more comfortable cars to better accommodate the steadily growing traffic.

To the engineer a far more interesting field is that of interurban traction, in which great and unwonted growth has taken place. Interurban railways have of late shown a very strong tendency to segregate themselves into two distinct groups, not yet fairly cut apart, but still united, like other varying species, by an indeterminate group of transition forms. One may describe the variant types without calling names, which the reader may supply for himself, somewhat as follows: A—The Megapolis & Minorville Rapid Transit Company. This interesting system has just completed its fifty-three-mile line, which is double-track already to Hobo Park, eighteen miles out. The company owns its right of way for forty-four miles, and has built and ballasted its road-bed on approved steam railway lines as far as has been possible. The track is of eighty-pound T-rail, save near the termini, where ninety-five-pound tram-rail has been laid. The maximum grade is five per cent. The power station at Hobo Park is equipped with four 1,000-kilowatt, direct-connected, *n*-phase, twenty-five-cycle generators, driven by cross-compound, condensing engines at seventy-five revolutions per minute. Steam is supplied by a battery of twelve P. D. Q. water-tube boilers, guaranteed for 150 pounds working pressure. Power is transmitted at 10,000 volts to substations, with rotaries, at Dinglehurst, Mortgageheim and Scragg's Mills. The further details of a technical character may be found in the back numbers of the ELECTRICAL REVIEW and other journals. The company proposes to run magnificent, newly designed, forty-eight-foot cars, equipped with four fifty-horse-power motors, and will make the run between termini in two hours and a quarter. The line has not yet gone into full operation, as there is trouble over a grade crossing with the M., X. & Q. R. R. at Scragg's Mills, and the local authorities at Crackerville

have an unsettled injunction owing to the action of the road in dodging the village by half a mile, in spite of some agreements of the promoters, now in dispute.

The writer defies any one to recognize the composite portrait here presented, but it is thoroughly typical of a class of interurban roads which is growing with extraordinary rapidity. It is, in all essential respects, comparable with ordinary railroads, save that it utilizes electric power, and, while possessing a freight franchise, does not intend, for the present, to utilize it except for light business. It uses the public domain only to a minor degree, and, while it does not like to be bothered by the restrictions imposed on ordinary railroads, is, *de facto* if not *de jure*, a direct and dangerous competitor.

It is, moreover, in virtue of such competition, a most useful and valuable public servant, worthy of every kind of encouragement that is consistent with public safety—so long as it remains a genuine competitor. It would do well to accept the situation at Scragg's Mills gracefully, and go over or under the M., X. & Q. R. R., as the authorities may direct, and, on the other hand, the good people of Crackerville should be thankful that its station is not a mile away, like that of the M. X. & Q., and that they will get a car every twenty minutes instead of three local trains a day. Technically, these heavy interurban roads have not as yet generally shown features of special interest, unless in details. Their greatest need is a thorough equipment in the matter of safety devices, for, while doing railway work, they have seldom availed themselves of the long years of railway experience in this particular. The electrical outfit of such roads is usually of the very best, and, although the method of distributing power along the line leaves much to be desired in the way of cost and efficiency, it still does the work well and the traffic is usually heavy enough to let the end justify the means.

One of the most interesting announcements of the year was that of the adoption of an alternating motor system for an important line of this general character. If successful, the effect on interurban practice, at least, will be prodigious, for the weakest features of our present methods of distribution are the necessarily low voltage on the working conductors, and the cost of apparatus and attendance entailed by the substations. Evidently the lesson of the famous Inner Circle litigation was not entirely lost on American engineers, and, while any alternating motor system must be tried by the touchstone of experience, the subject can not safely be laid aside on *a priori* grounds.

B—The Petrarch, Ravenna & Jonesville line was opened for traffic early this autumn. It forms the connecting link between the B. P. & S. and the M., V., Z. & D. railroads, and gives Ravenna, which has built since 1895 five churches, two hotels, two banks and an opera house, a much-needed outlet to the East. The new line has thirty-four miles of single track, with turnouts. It runs along the county road, save at half a dozen points where it cuts off distance considerably by acquiring its own roadway, and covers a fine farming country, replete with villages heretofore reaching the outside world by daily stages. The whole line is laid with sixty-pound T-rails, and is fairly straight and level save near Jonesville, where the curves and grades would turn a corkscrew green with envy. It has two power stations—at Petrarch and Ravenna, respectively—and a booster system to Jonesville, which will be sorely needed when the circus comes. Petrarch is an important manufacturing and distributing centre, and the traffic on the line is large and growing. The running time is two hours and a half, and the fast and commodious cars leave little to be desired in the way of comfort.

Minor interurban lines of this general character have been built with astonishing frequency in the past year or two. They have already come to be a feature in American life. Joining as they do several large towns or small cities and running for the most part through rural communities, they serve a most important purpose in unifying the life and interests of the districts affected by them. They tend to break up the isolation of the smaller country towns and to render them more desirable places of residence. Such roads differ radically from the heavy interurban lines just described in that they operate largely on the public roads, seek local traffic rather than avoid it to save time, and supplement rather than supplant the existing steam railroads. Their function is to add to the rapid transit facilities of the country, and particularly to serve the smaller communities. Ordinary railroads unquestionably feel their competition, sometimes acutely, but find them to a certain extent feeders. The minor interurban lines retain many of the essential characteristics of street railways, which roads of the major class strive to avoid. It is hard to say too much for the public utility of roads like the P. R. & J., and the building that has been going on during the season just past is a matter of public congratulation.

But such roads occupy a position that is sometimes difficult to define with respect to their obligations to and relation with the community. The larger roads, viewed from a practical, common-sense standpoint, are in every essential particular ordinary railroads, and should stand morally and legally squarely in that position, save as they may incur added responsibility from running in some small part through public property. The smaller roads so run for most of their length, and thereby can be extended and utilized more freely than ordinary railroads, electric or other; but in so doing they incur risks and responsibilities that can not lightly be put aside and which become greater as the running speeds tend to increase.

To tell the ghastly truth, roads of the interurban class, big and little, have made a peculiarly bloody record for the year 1902. Accidents of all kinds have been frequent and the casualty list has grown to an appalling length. The statistician may show that the fatalities have not been numerous compared with the number of passengers carried, but no computations can conceal the fact that very terrible accidents have occurred and that very few of them have belonged to the unpreventable class. Not only have cars been run at dangerous speed in many instances, but they have been run with a reckless disregard of the rights of other vehicles on the public highway. There is a natural tendency to give a heavy and fast electric car a wide berth, but this does not give the car an undisputed and invariable right of way, in spite of a popular impression to that effect. Cars have often sinned and have likewise been sinned against, as in the notorious automobile case not many weeks ago. The fact is that very few people realize how difficult it is to stop an electric car when running at anything above very moderate speed. The papers on braking recently read before the American Institute of Electrical Engineers throw a rather lurid light upon the subject. Without going into the details of these very interesting researches, it appears very plainly that even under favorable conditions, with the brakes working well, it takes something like fifty yards to bring an ordinary electric car to rest with hand brakes when running at about fifteen miles per hour. Even with good power brakes, as now in common use, a stop at this speed requires about thirty yards of space, and it is self-evident that a corresponding degree of

caution must be observed by all parties concerned.

It is not at all necessary for a collision that the brakes should be out of order, or should not be applied promptly. If a car is making high speed it must have a considerable stretch of clear track in which to stop, even when everything is working at its very best. To use hand brakes under such circumstances is to court disaster, and no excuse is sufficient to justify their retention on lines running along public roads at anything but very moderate speeds. To ensure even a reasonable degree of safety not only must power brakes be used, but the speed on the public thoroughfares must be kept down to a point considerably below the speeds that are now increasingly common. Speeding automobiles on the road is bad enough, but speeding an electric car is, on the whole, worse, since of the two the former can both stop far more quickly and can turn out if necessary.

To leave this unpleasant subject, it is worth noting that another year has slipped by without bringing perceptibly nearer the high-speed electric railway, which has been periodically heralded for the last decade. The Zossen tests made it more plainly evident than ever before that the high-speed problem can be solved without any particular trouble when anybody wants to foot the bills. So far no one has felt yearnings that way, and in this country at least the strength of what we are pleased to call vested interests is sufficient to effectively block the way of any such revolutionary enterprise. The larger interurban lines are gradually approaching what one would consider as rather high railway speeds, and at least one such road is down for a mile a minute between stations. But this is rather to be regarded as meeting the advanced suburban work of existing railroads than as marking a new era in pure electric railroading.

Perhaps the most striking single event of the year was the final accomplishment of electric traction on the Manhattan "L". It had been talked about for years, had been in preparation for some more years, and now at last it is. It can not be said that the change has as yet wrought unalloyed bliss for the passengers. The system has already made a collection of minor accidents that with the old equipment would have taken some years to accumulate, and capped the climax by breaking down completely during the recent sleet-storm. Not having been on the ground the writer can not with certainty aver how far this pretty state of things was due to bad planning, bad execution, or bad luck. It is certain, however, that other third-rail elevated roads have been spared a similar affliction, and that the thing is neither inherent in the third-rail system nor properly chargeable to causes beyond human control. There is little doubt that hidebound railway men will make the most of it as an argument against electric traction and that it will be many a long day before we hear the last of it. Elevated roads are a particularly good field for the third-rail method of operation, and while it is admittedly not perfect it has proved thoroughly reliable on a large scale.

In the line of the larger problems of electric traction comes the equipment of underground roads in the metropolis and elsewhere. Here the third rail is entirely withdrawn from climatic influences and the engineers are proceeding on entirely safe ground. That surface and elevated extensions of such lines can be similarly worked with entire success admits of no doubt in spite of the sleet difficulty.

A certain strategic step in electric railroading of sufficient interest to be worth more than a passing mention is to be noted in the recent completion of an interurban line between Concord and Manchester, N. H. The line is neither exceptionally long nor for exceptionally high speed, but it is notable as forming an integral part of the Boston & Maine system and as being planned, built and equipped along railway lines, although in great measure following the public roads. Technically, the special feature here to be noted is the practical application of the multiple unit system as part of the normal operation of a surface road, but in point of policy it is unusual.

The Boston & Maine Railroad has the state of New Hampshire just about where another system has the state of Connecticut, and has pursued the policy of acquiring franchises on routes that looked a bit dangerous to its traffic. This line marks the next step in the game. It is admirably built and equipped and is expected to take its place as a regular part of the system in relieving the main line of local traffic. In other words, the steam line and the electric line are to be operated as a unit. It is too early yet to judge of the final results of this policy, but it is unquestionably a very shrewd move to not only remove the possibility of active competition but to pocket the benefits that the public might derive from it. From a civic standpoint, however, the wisdom of granting a railroad the use of public thoroughfares, wherewith to throttle competition, is at least open to criticism. If electric railways, and particularly interurban railways, are to reach their full usefulness they should do something more than be addenda to existing railroads.

The past year has done comparatively little in advancing the methods and apparatus used in electric railroading. In fact for several years past the main work has been in thorough-going standardization and in the finer working out of operative details.

So far as power stations go, bigger and more massive apparatus has been the order of the day, and about the only new tendency to be manifest is a growing feeling that the steam turbine is likely to play a not unimportant part in the near future. Very little of a concrete character has yet been accomplished, so far as electric railways are concerned, but the trend of feeling is very evident. The effect of introducing the turbine would be twofold. In the first place it would make the design of urban stations, employing power transmission, easier by reason of the great compactness of the apparatus; and secondly, it would make it rather easier to erect efficient auxiliary stations of moderate capacity. Up to the present time it has been the almost universal practice to use power transmission to rotaries in cases when the network has out-grown the capacity of a reasonable feeding system. The Boston Elevated Company is almost alone in its policy of adhering, thus far wisely, in the writer's opinion, to independent auxiliary stations. With the steam turbine available for units of moderate size, and conspicuous for its good work at moderate loads, this policy may prove to be advisable in cases where the traffic is much less dense than it is in a large city. At all events we are likely to hear much of the turbine in the next year or two, and it will soon be tried on a scale that will make its virtues, and perchance vices, evident.

Altogether the record of the past year in electric traction has been one of almost uniform success and of striking growth, with few sensational features. Men have gone about building roads in a quiet and businesslike way and the results, technical and commercial, have been generally good. There are times when the world is well content with pegging along on well-tried roads and 1902 has been one of them. There are indications that the year now beginning may be more prolific of head lines, but it can scarcely show a more substantial and satisfactory growth than has the one just now ended.

Evolution in High-Voltage Transmission.

By Charles F. Scott.

HIGH-VOLTAGE transmission underground in cities and overhead for greatly increasing distances and for greater quantities of power has demonstrated its engineering and commercial success. This is the justification for extensions and for new undertakings of increasing magnitude. Electrical transmission has ceased to be regarded as an experimental novelty and is classed among the common engineering methods of carrying on the world's work. The question which is put to the electrical engineer is no longer, Can it be done? but it is now, What is the best way? I would class the growing confidence of the public, of engineers and of investors as one of the notable developments in electrical work in general and in high-tension transmission in particular.

Steady progress has been made by engineers in advancing the voltage for commercial operation. Additions from the unexplored and undeveloped regions of high voltage have been conquered and made subservient to commercial service. The line between the practicable and the indefinite and experimental has continually advanced. This has been the work of the electrical engineer. The past ten years have marked a most notable development. It has been an evolution. Each increase in voltage has introduced new problems. Problems have become more complex. New classes of phenomena are revealed and new difficulties are encountered. The early insulation difficulties which were at first experienced with a few hundred volts and then with a few thousand volts were overcome only to bring to the designer new problems at 5,000 or 6,000 volts. There was a time in the easy recollection of many of us when 5,000 volts inspired the same respect and awe that were afterward experienced when 15,000 and 20,000 volts were to be undertaken. Later, when this had been achieved, voltages of 40,000, 50,000 and 60,000 are being made practicable. Problems in construction and design and in insulation of apparatus, problems in insulators and line construction, problems in switching, controlling and measuring current, problems in lighting and static protection have been presented and solved with each advance in voltage.

As notable perhaps as anything else has been the advance in the voltages for which suitable cables are constructed for underground service. In overhead construction air is so good an insulator that it is necessary simply to support the wires at one point in a hundred feet or more. In a cable every inch must be insulated by material which must be thin and flexible, durable under electric stress, and in which an infinitesimal imperfection may instantly develop a catastrophe. To-day, 10,000-volt cables are on a par with 1,000 or 2,000-volt cables a dozen years ago, and 20,000 or 30,000 volts occupy the position which 6,000 or 10,000 volts held five or six years ago. The difference in the cables has not come through the haphazard ideas of some brilliant inventor, but from the intelligent, painstaking study of materials, particularly when their qualities are revealed through the aid of a high-voltage testing set. Not only do advancing voltages demand a high grade of engineering work for underground and for overhead transmission, but the larger quantities of power to be handled impose new requirements. Witness the first 10,000-volt transmission plant in America. There were twenty transformers, each of six kilowatts, with their 500-volt secondary coils in series to produce 10,000 volts. High-tension switches were unnecessary. There were neither lightning arresters nor lightning. There was little rain or fog. The current was so small that a No. 8 wire was sufficient. The service was incandescent lighting in the evening. Compare Pomona with Niagara or Manhattan. For several years the Niagara-Buffalo transmission voltage was the same as that at old Pomona, and it is the voltage now used by the Manhattan Railway Company. But the building of transformers for 2,000 kilowatts, and the winding of the largest generators for high voltage, and the switching appliances necessary for distributing tens of thousands of horsepower to many distributing points, and the regulating and protective devices essential for reliable operation of a great system—all these things mark the evolution which has come from what seems now to have been a most elementary beginning. Elementary it does seem now, but there was a time when the difficulties in getting those little Pomona transformers to stand their insulation tests did not seem particularly elementary. The advance has been progressive—to higher voltages, to larger powers, to more complex systems. It has been an evolution. What has been satisfactory in one plant, has been insufficient in the next. Scarcely are new conditions met with new appliances than larger demands and more exacting requirements render them inadequate. Hence the constant change in types of apparatus and methods of construction. Inspect a recent large transmission plant or power station and you will find very little that is five years, or even three years, old. In a few years apparatus seems crude and becomes inadequate and obsolete. It may do what it was made to do, but there comes a new demand. To meet this demand—to anticipate it when possible—requires adequate theoretical knowledge combined with intelligent experimental laboratory tests and actual experience with working conditions, together with skill in design, and each advance requires a higher order of ability.

In considering the present status of high-voltage transmission I have dwelt particularly upon what may be termed the evolution in electrical engineering, with a specific object in view. High voltages have become so common that they no longer inspire awe, except in those who know them best. But many people regard high voltages with the undue familiarity which breeds contempt. Although 40,000 and 50,000-volt transmission lines may be in successful operation, it is no assurance that everybody can design a line for 30,000 or 20,000, or even 10,000 volts. A design for a pole line for one of these voltages was recently presented for inspection. It was returned with the remark that it would do for 2,000 volts, but was wholly inadequate for the voltage intended. The designer of the pole, with its little insulators and short pins, insisted that the design must stand, as the material had been ordered and he would certainly expect the company which had the contract for the station apparatus to furnish apparatus which would work with his line. Such an appreciation of electrical matters reminds one of Mr. Dooley, who confided to Hennessy that "an ohm of electricity is equivalent of about one quart of the electric fluid." The sooner 100-volt or 1,000-volt engineers stop trying to make 20,000 or 30,000-volt lines and cease talking familiarly about 50,000 or 60,000 volts, the better for all concerned.

The problems in transmission are engineering problems. How well they are solved is attested by the operative and commercial success of electric installa-

tions, by the extension of many of the large plants and by inauguration of new undertakings. Many problems have been solved and a wide field is no longer to be considered experimental and uncertain. There can be no excuse for repeating the mistakes which may at one time have been inevitable. There is no credit to the electrical engineering profession in reducing the efficiency of electrical enterprises by incessant blundering. The manager of a large company recently remarked that half of the troubles in the operation of the company's work resulted from the collective stupidity of the men—not that they were dull, but that they made the same mistakes over and over, that they did not apply reasonable intelligence to ordinary things, that they often did not work together, they did not cooperate to get the best results. The tasks before the electrical engineers of America and the responsibilities which rest upon them call for the most earnest endeavor, the most efficient cooperation. This fact has been recognized by the American Institute of Electrical Engineers. A transmission committee has been appointed for the purpose of collecting data with respect to present practice in high-tension transmission, particularly with reference to transmission lines, and of formulating this data in such a way that it may be of immediate value to electrical engineers. It is to crystallize from present practice that which is best and make it standard practice. The success of the work of this committee depends upon the cooperation which it receives from those who are operating transmission plants, and the results will, in turn, be of the highest value to them.

By establishing standards we do not limit progress, we make definite the steps already taken and we lay the foundation for the future.

A notable event of the past year in electrical transmission is the starting of the electric plant of the Manhattan Railway Company. The generators for this plant are the largest ever built, both in dimensions and in output. New types of construction were employed, new tools and new shop methods were necessary, the dimension lines on the castings were laid out by a specially constructed transit, the machines were assembled and wound in the power-house, the eighth generator was started within less than a year after the first one; rotary converters of fifty per cent greater output than any previously constructed were made and put in the substations, and the plant has operated through an extensive system of cables at 11,000 volts, and all—design, construction and operation—has been effected without a snarl. And the most significant thing about it is that nobody is in the least surprised. That which nobody would have thought of undertaking a few years ago is now so commonplace that it does not occasion remark.

The transmission problem is an engineering problem. The more clearly this is recognized the more certainly will there be success in the field of present operation and advancement into new ones. That advance is to be anticipated as the result of a process of evolution—a scientific advance from the known to the unknown, from the accomplished to the unachieved.

Recent Lighting Progress.

By Henry Noel Potter.

IN THE field of electric lighting, the closing years of the last century may be said to have constituted the crest of a wave of successful inventive protest against established methods.

A very important part of the progress of the past year has been in the public appearance of the lamps based on the inventions of this earlier period. The most striking thing from this general point of view is the fact that each of the new lamps is a radical departure, in which efficiency has been secured at the expense of some minor characteristic. Altogether there is evidence of a general feeling that progress along the old lines had become too slow to be attractive.

For twenty years the arc and incandescent lamp each held its own, becoming better and cheaper, but never radically different, until it began to look as though the carboniferous age of electric illumination would never behold the light of a new era.

The light of the arc is due primarily to the intense incandescence of the electrodes. The carbon vapors in the arc itself do not compare favorably with certain other vapors, either in the amount of light emitted, or in their electrical conductivity. By substituting for the vapor of carbon in the arc the vapors of other materials—for example, highly luminous vapors of barium or calcium—the conductivity and length of the arc can be greatly increased, and the light emitted by the arc can be made to greatly exceed that emitted by the incandescent electrodes.

The best known incorporation of this system is the "Bremer" lamp; two of which have been in operation before the Plaza Hotel, in New York, during the past year.

Instead of using vapors existing only at extremely high temperatures, vapors existing at comparatively low temperatures can be made to conduct and give light, with the added advantage that they can be enclosed in a transparent glass tube. In this type of lamp there is, therefore, no continuous loss of material, and, consequently, the life of such a lamp becomes indefinite, by which is meant that it is terminated either by accident or some cumulative secondary reaction. The representative of this last class of true vapor lamps is the Cooper-Hewitt light, which was first exhibited somewhat more than a year ago.

As an incandescent source of light, carbon has also several weaknesses. One is that, despite its ultimate refractoriness, nevertheless, it wastes away by sublimation even at temperatures quite within the range of other bodies to withstand. A second weakness is that it is capable of radiating all wave-lengths equally well, and, therefore, requires the maximum of energy to keep it hot. A third weakness is that it oxidizes in air at high temperatures, and must, therefore, be run in a vacuum, which necessitates renewing the globe as well as the filament, but which has compensating advantages in avoiding losses by convection. A fourth weakness is that it conducts so well as to necessitate long, thin filaments which waste away and break down more quickly than if they were comparatively short and thick.

Among the bodies which are extremely refractory and which sublime very slowly below their melting points are the metal osmium, the basis of the osmium lamp, and the rare earths. The latter, when incandescent, have a much higher specific resistance than carbon, and, in addition, radiate the short visible wave-lengths more readily than a portion of the long invisible ones, and, therefore, require less energy to maintain them at a given temperature than carbon does. These bodies are, therefore, peculiarly suited for use as sources of light, and they form the basis of another one of the new lamps; namely, the Nernst lamp.

We thus perceive that progress has been made in the "flame light" arc and Hewitt lamps by exalting the luminous power of the vapors corresponding to the arc itself

in the arc lamp; in two other cases—the osmium and the Nernst lamps—by the incandescence of materials which are less volatile than carbon at temperatures at which they are used.

As I have stated, each of these developments is accompanied by an advance in efficiency, and it is interesting to take up each of these new lamp systems somewhat in detail, so that we may arrive at an estimate of the right of each to exist and the placing of each in the general art of electric lighting.

THE OPEN VAPOR LAMP.

It has been known for many years that the color and efficiency of the arc light could be materially changed by adding to the carbon salts of metals—the spectra of which are very luminous, particularly the metals of the so-called alkaline earths—barium, strontium and calcium.

In practice the problem of securing a good, clear, steady, quiet-burning light, is by no means simple, and can not be considered solved. The action is greatly complicated by the fact that it must take place under atmospheric pressure and in the presence of the oxygen and nitrogen of the air.

The fact that the salts of the metals used are rapidly boiled away, gives rise to clouds of vapors which must be carried away by a draft of air or induced to settle upon cool surfaces, where their presence will interfere as little as possible with the emission of light by the lamps.

This question of deposit has resulted, in the case of the Bremer lamps, in a novel design of the mechanism of the lamp itself. The arc is maintained between almost parallel vertical carbons projecting downward into an inverted cup upon the walls of which the deposit settles and serves as a diffusing reflector. The light is thus distributed principally throughout the lower hemisphere, a system of growing popularity.

Impregnated carbons are also produced for use in ordinary open arc lamps, and these also give a light which is much stronger than that produced by the ordinary carbons.

It is too early as yet to estimate the effect of these new carbons upon the arc light industry, but it would seem that for lighting, where a very large candle-power unit can be used, that this system presents healthy progress. On the contrary, for lighting where a white color is requisite, and particularly where smaller units are advantageous, it is hardly to be expected that this system can compete with others.

The color of the light produced from calcium salts is so rich in long wavelengths, that it would seem that this would be a good fog-piercing light, and should therefore have special value for lighthouse work.

THE ENCLOSED VAPOR LAMP.

The only enclosed vapor lamp which is commercial in not requiring excessive voltage or impractical frequency is the Cooper-Hewitt lamp. This lamp bears certain analogies to the open vapor lamp, in that the luminous conducting medium is a metallic vapor. However, here the vapor chosen is that of mercury, a metal which volatilizes at so low a temperature that it can be enclosed in a glass chamber without injury thereto. The fact of using a vapor so enclosed profoundly modifies the physical characteristics of the lamp as a whole, inasmuch as the action is now far more controllable because the influence of atmospheric pressure is absent, the complications resulting from the presence of oxygen and nitrogen are removed and the loss of the active material is avoided. It will thus be appreciated that in the Cooper-Hewitt lamp we have the phenomena of vapor conductivity in absolute purity, save for the reactions occurring at the electrodes.

Unfortunately, the spectrum of mercury does not contain all the colors necessary to combine into a white light of good quality. There is scarcely any red in this light and its resulting color tone is consequently distinctly green, although such is the brilliancy of the light when looked at directly that it appears almost white.

In one very large field of modern lighting, the absence of the color red is of no importance. In fact it is a positive advantage not to waste energy in producing it. This field is that of photography.

In the gradually increasing glow of the lamps, the Pan-American Exposition witnessed almost the last variation possible in incandescent lighting decoration; it is with pleasure, therefore, that we welcome the novel and pleasing effects which modern Aladdins can conjure up, by commanding the genius of the Hewitt lamp.

The actual progress of this lamp during the year has been in the installation of a large number of photographic and photo-lithographic works, in incorporation of the Cooper-Hewitt Electric Company, and in the development of a series of standard combinations of lamps and starting devices, for various purposes.

THE OSMIUM INCANDESCENT LAMP.

This lamp has been developed by Dr. Karl Auer von Welsbach, the well-known inventor of the Welsbach mantle.

It is very similar to the ordinary incandescent lamp, and consists of one or more filaments of metallic osmium enclosed in a glass bulb, from which the air has been exhausted. Osmium is a metal and consequently conducts electricity, not only at the temperature of incandescence, but also at ordinary temperatures, so that it requires no auxiliary starting device. The temperature coefficient of osmium is positive, the resistance increasing with increased temperature.

It is not as yet possible to draw osmium into wire, and the fine filaments for these lamps must therefore be built up by the reduction of osmium salts absorbed in a thread or by analogous means.

Dr. Auer in his specification describes methods of accomplishing this, but it is generally understood that great improvements have been made in this feature of the manufacture, and that the filaments can now be made quite cheaply.

Just at the close of the year, the announcement comes from Berlin that the German Incandescent Gas Light Company is prepared to deliver osmium lamps for potentials of fifty volts or less.

It would therefore seem that the problem of producing 110-volt lamps still presents certain difficulties, presumably owing to the extreme length and limpness of the filament. The efficiency and life claimed for these lamps are far better than is possible with carbon incandescent lamps.

One of the obstacles to the production of these lamps, which has been frequently mentioned, is the extreme scarcity of the metal osmium. However, as there has been scarcely any use for the metal hitherto, it would seem probable that minerals containing it will now be sought after with great diligence, and a reasonable supply of it will be discovered.

It would seem that owing to its low voltage and the possibility of the manufacture in small candle-powers, that the osmium lamp will find its field in low voltage isolated plant lighting from storage batteries. A low voltage lamp having twice the efficiency of the incandescent lamp would be more than equivalent to cutting the weight of the battery in half, so that it may soon be possible to realize a lighting system supplied from batteries, which are rented out and returned to the central station for charging. With a low voltage lamp the number of storage cells is small and each cell may be made strong and durable.

It is understood that the osmium lamps will be introduced in America by the Welsbach Lighting Company. We

may therefore confidently leave its future in its energetic hands.

THE NERNST LAMP.

With the Nernst lamp the general lighting public is much more familiar than with any of the other novel lamps. This lamp has been on the market for a year in four sizes, ranging from 88 to 530 watts, and has reached the stage where interest in its progress is directed more toward the commercial and manufacturing side than toward the development of the principles on which it operates. Viewed from this standpoint, the progress of the Nernst lamp has been marked by a steadily increased sale, extending very uniformly over the entire country.

The capacity of the factory has been strained to its utmost during the year, and a continuous increase in the plant has been going on in parallel with the manufacture of the lamps. The processes involved in the manufacture of glowers, heaters and ballasts have undergone great refinement, and constitute probably the most interesting progress made during the year in this industry.

The influence of the Nernst lamp is already being felt upon systems of lighting, and constitutes a most powerful argument in favor of 220-volt circuits and the use of alternating current.

As the Nernst lamp distributes its light principally throughout the lower hemisphere, its introduction marks progress along a line which leads us to appreciate a lamp as a factor in illumination, quite aside from any academic advantage of its being easily measured.

Another great advance introduced by the Nernst lamp in artistic illumination lies in its uniform white color throughout all sizes. General lighting effects are distinctly better where one color of light is maintained throughout an entire floor or other area visible as a whole.

Great progress has been made during the past year in the development of a direct-current Nernst lamp, and its introduction may be expected as soon as the company feels capable of supplying an extremely large demand, with a lamp and renewal parts as excellent as those already tested.

ARC AND INCANDESCENT PROGRESS.

The progress made in the older forms of electric lighting has in general kept pace with the prosperity of the year just past. It is estimated that the consumption of incandescent lamps has reached about 30,000,000, an increase of about twenty per cent over the previous year.

It is thought that the growth of the arc lamp industry has been somewhat more rapid, although no reliable figures are obtainable. The prospect for the coming year is extremely hopeful. We may look forward to a greater specialization in lighting, as each of the new lamps has a well defined field, the extension of which in the coming year need not be expected, however, to prevent the continued prosperity of the older types of lamps.

Record of the Year in Wireless Telegraphy.

By A. Frederick Collins.

THE history of wireless telegraphy during the year last past has not been excelled in brilliancy of conception, or success in execution, by any other branch of electrical science.

The dominating factors in this struggle for supremacy of the omnipresent ether has resulted in the development of the art of sending signals without wires, according to different theories, the most important of which tend toward simplicity of construction, rapidity of transmission, economy of operation, syntonization, and, last but not least, long-distance transmission.

The personnel in this modern movement of science is extremely interesting and embraces the names of men who attained prominence in its infancy as well as those whose names have lately flashed upon the public eye; and each, without distinction, deserves credit for the part he has played in the latest achievements, but not more so than those of whom the world hears little, strenuously toiling with abstruse theories upon which the ultimate success of wireless telegraphy so largely depends.

Chance so favored the Occident that the first commercial message was transmitted from American soil, to the greater glory of the new world, and at the close of the period under consideration, as indeed throughout the history of electric wave telegraphy, "on the roll of those accounted best, Marconi's name leads all the rest," and his fame rests not only on his recent great successes but on the resources of his brain, as typified in the evolution of his invention.

To Americans, more than to any other nationality, is due the credit of striking originality in the devising of ways and means for accomplishing desired results and overcoming obstacles which beset wireless telegraphy in practice.

Professor Reginald Fessenden has been most assiduous in the pursuit of theoretical knowledge and the application of theory to practice; his discovery for the production of a pure sine wave is, in my opinion, one of the most important made in the last year; he has, likewise, done some exceedingly clever work in syntonization, the result being a method of combining electrical resonance with mechanically produced resonance, and, finally, the theory he evolved of sliding half-waves is most ingenious and widely accepted. Dr. Lee De Forest has shown his ability in the perfection of a device which has done much toward eliminating the older, slower methods of transmission; his "responder," consisting of metal filings held in suspension in a viscous medium, and a telephone receiver taking the place of the coherer, tapper, relay and Morse register, formerly employed. The De Forest "responder" and the Fessenden "barretter," a wave detector consisting of a minute silver loop having a platinum core and having a small radiating surface in proportion to its mass, offers a speed of reception equal to wire lines, and in employing detectors of these types simplicity of the receiving appliances follows as a natural sequence; another feature is the great saving in the expenditure of energy at the transmitting station, since the total energy of the oscillations set up in the resonator system is utilized. The result of this saving may be manifested either in economy in sending over a given distance, in obtaining a longer range of transmission with the same power, or in shortening the masts.

The De Forest company operated commercially for the first time in 1902 a transmitter employing an alternating current as a source of electromotive force, and by transformation utilizing the high potential at the terminals of the secondary to charge a battery of Leyden jars, which in turn discharges across the air-gap, and marks an advance in transmitters, in simplicity, efficiency, economy and reliability.

A new name registered to enter the lists is that of John Stone Stone. Recent patents issued to him show that he has made an exhaustive study of electrical resonance and its relation to syntonic

wireless telegraphy. Mr. Stone has devised means for producing oscillations in the radiating system as rapidly as the preceding ones are damped out by their conversion into radiant waves; at his stations on the Charles River embankment he has shown it possible to transmit selective signals when the difference in frequency is not more than ten per cent, which result marks a new era in syntonization.

In England, Sir Oliver Lodge has again taken up the practical side of wireless telegraphy, and has put into operation a system which it is claimed is not affected by the powerful radiations from the Poldhu station. Sir William Preece, who made it possible for Marconi to demonstrate his invention in 1895, is himself at work between Holyhead and Ireland. Professor Fleming of Oxford College, who has acted as the technical adviser of the Marconi company, has had issued to him patents bearing on the transformation of electric oscillations.

Dr. Slaby, who did a great deal early in the past year, has made no new announcement recently and it may be safely assumed that his attention has been attracted to other scientific investigations. In Germany one of the notable advances was the elimination of the earth as a factor in oscillators and resonators by Dr. Braun, and others are his application of oscillatory condenser discharges to wireless telegraphy and his apparatus for the production of pure undamped oscillators.

Herr E. Lesher has investigated the influence of electrification of a disruptive discharge. Herr P. Dinds devised a method for determining the period of rapid oscillations, and M. Ferrie deduced the part the antenna plays in the emission and propagation of electric waves, each of which will have its impress upon the question of syntonization in the future.

Again, the results obtained by Professor Trowbridge in the action of an electric discharge of high potential in water, and Lord Rayleigh's deductions of the effect of inductance on syntonic systems, showing that when the capacity of a radiator system is increased beyond a certain critical value, the "grip on the ether" is greatly diminished; these are not only of great interest, but show full well the straight and narrow path to be followed by designers of both syntonized and non-syntonized apparatus.

One of the theoretical products of the year was Professor Seibt's introduction into the mathematical theory of electric waves, and another the observation of Dr. Zickler on the action of ultra-violet radiations on spark-gaps in parallel. In view of the fact that the dissipation of energy by daylight was noted by Marconi, the results obtained by Zickler may aid in solving the problem of diffusion by daylight.

It is extremely interesting to note the reappearance into the field of Prof. Branly, the original inventor of the coherer, and his active interest in the practice of wireless telegraphy; the advent of the new Branly tripod coherer and that invented by the Marquis Solari were two events which created mild furors in the wireless world in 1902.

A review of the successes of wireless and cableless telegraphy for the year has proven that long-distance transmission is not only possible, but absolutely feasible; it has proven the great value of the system on the high seas, and it has proven that there is no obstacle so great but that by dint of perseverance it may be overcome, and syntonization will be no exception.

It is true that the measure of results is not full when selective signaling is considered, but it must be borne in mind that the entire art is yet very young; on the other hand, it is obvious that much of the mystery of electric oscillations, of electric resonance and of electric waves has been cleared away. The past year did its part toward producing a syntonic system based on sound fundamental principles.

In England the objection to cableless telegraphy has been raised on the scores of non-syntonization and the high time-constant of transmission. The commercial solution of the former, it is true, has not been perfected, but it has been deduced mathematically, solved theoretically and demonstrated experimentally, and thus the way has been blazed for its practical application. In view of these considerations the difficulties to selective signaling are not nearly so great to-day as those which beset the transmission and reception of cableless messages a year ago.

The element of time required in transmission may be dismissed from the list of obstacles, for while it is admitted that an appreciable period is required under the present system for cutting in and out high-frequency, high-potential currents, representing an energy of fifty kilowatts, it is resolved, after all, into an ordinary electrical engineering feat.

So much for the past year! What new wonders during this year will materialize, seemingly to defy the laws of nature, astound the senses and mystify the human mind?

To those versed in the art and who understand the science of deduction, no psychological ability is required to determine that a complete chain of wireless telegraph stations will be established on the seacoasts of the continents, whence cableless messages will be flashed "'round the earth" in less than forty minutes, and thus outdo the modern Puck.

An Electric Steering Gear.

The Earl of Crawford's yacht has been fitted with an electrically controlled steering gear installed by Siemens Brothers & Company. The ordinary hand-steering gear has been altered slightly to adapt it for electrical driving. It consists essentially of a cast-iron frame bolted on the deck, through the base of which passes the rudder post. To this post is secured a massive cross-beam. Above this is a right and left hand screw on which travel nuts attached by links to the cross-beam. These nuts are prevented from turning by guides. The screw is arranged to be driven through gears by a four-pole motor. It can also be operated by hand if necessary, a clutch being provided for this emergency. The motor is series wound and fitted with a brake which is held off by electromagnets while the motor is running. The motor is controlled by two special switches, one for each direction of rotation. These operate as follows: Two switch arms are mounted on two pins on a metal disc at equal distances from its centre. The disc is geared to the screw and its motion is proportional to that of the rudder. The switches have cranked arms which can be pressed by stops, as shown on a second disc mounted concentrically with the first, so as to put the switches on or off. The second disc is connected through gearing with the steering wheel, and its motion is proportional to that of the wheel. The operation of switching on or off is the result of the difference in the motions of the two discs. The cranked arm of each switch is so shaped that it clears the stops on the second disc when the motion is in one direction, but engages them when the motion is in the opposite direction. This prevents more than one switch being operative at a time. The discs are further provided with stops to limit the difference of their motions to a little more than the amount actually required to operate the switches. Twelve complete turns of the steering gear will move the rudder through 180 degrees. Stops are provided which prevent any further motion and which cut out the motor when the limit has been reached. Trials of the apparatus have given satisfaction.

A Three-Wire Electric Railway System Operating between Grenoble and Chapareillan (France.)

By Enrico Bignami.

GRENOBLE, a town of 65,000 inhabitants, capital of the department of Isère, recently put into service an electric railway which unites it with Chapareillan, on the border of Savoy.

This railway is of evident technical interest owing to the fact that it is the first utilizing 1,200 volts (continuous current) for traction. The two motors of the cars are coupled in series, each receiving 600 volts.

Owing to its length the line has a certain number of special boosting feeders, beginning at a little distance from the generating station.

The suburbs of Grenoble are justly renowned, and each year this section of the Dauphiné is visited by numerous tourists. On the other hand, a certain number of villages, principally in the picturesque valley of Gresivaudan, were deprived of frequent communication facilities. An electric railway was therefore ardently desired. The line just constructed enables tourists to admire the remarkable natural beauties of the country, and the inhabitants to have more frequent commercial intercourse.

As already stated above, this railway is technically interesting. The distribution of current is by means of the three-wire system.

Up to the present the maximum voltage allowed for traction using continuous current varied from 550 to 650 volts. This limit, relatively low, necessitates conductors of large section.

In installations for lighting and transmission it is customary to diminish this inconvenience by the use of three-wire distribution, which, while allowing an increase in the voltage limit, diminishes the expenditure for copper, but for traction, especially for a line of great length, no similar application had been made before. On the line, the tension between the outside wires is therefore 1,200 volts, the neutral conductor is grounded by means of a copper cable of 125 square millimetres section connected to the rails as a common return.

The generating station feeding the tramway line from Grenoble to Chapareillan (Fig. 1) is situated at Lancey, a small country place about sixteen kilometres from Grenoble. It is about three kilometres from the tramway line from which it is separated by the Isère. The motive power is taken from a fall of water 450 metres high. The water enters the station by means of a pipe of riveted sheet iron under a pressure of forty-five kilogrammes, and is distributed to the turbines by a collector situated outside the building. Discharge valves of special construction, necessitated by the enormous pressure of water, control directly the nozzles of the centrifugal turbines. There are three of these, of which one is held in reserve They each develop 340 horse-power at a speed of 325 revolutions. They each have a centrifugal speed regulator maintaining the speed practically independent of the load.

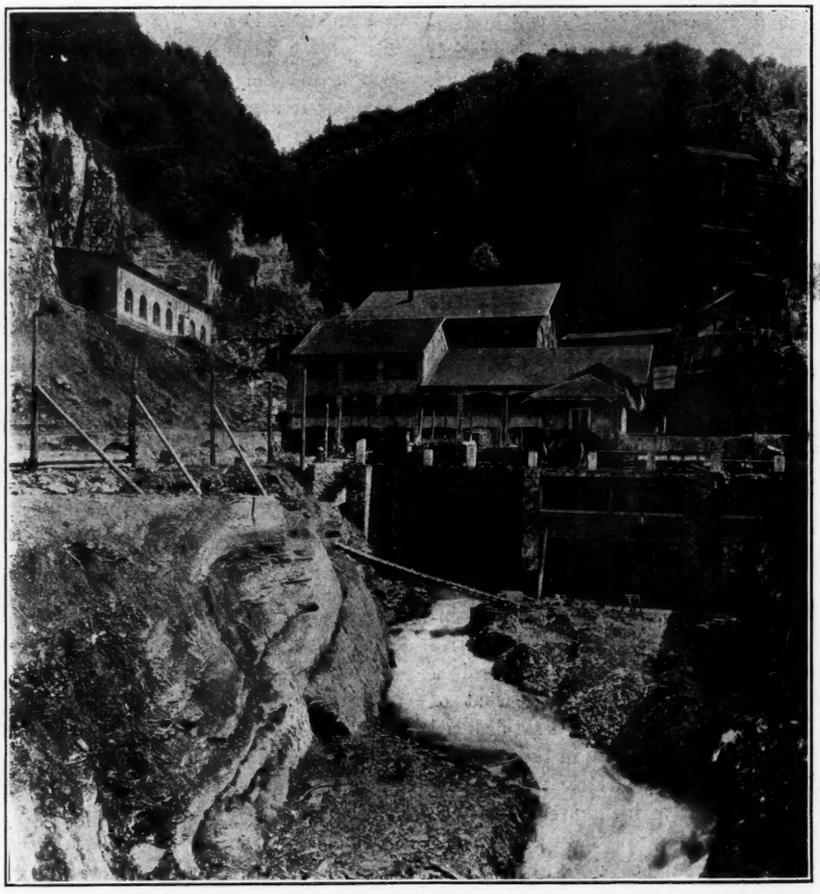

FIG. 1.—GENERATING STATION AT LANCEY, OF THE GRENOBLE-CHAPAREILLAN TRAMWAY LINE, FRANCE.

The water after its passage through the turbines goes to the meter. This is worthy of a brief description on account of its extreme simplicity. Owing to the considerable output of the turbines it was extremely difficult to measure directly the flow of water. The problem has been solved happily in the following manner: The water discharging from the turbines flows from below through an enormous funnel surmounted by a cylinder of copper. Eighty rectangular windows, carefully gauged, are made around the cylinder, the lower edges all being in the same horizontal plane. It can be seen that the water coming into the reservoir will discharge by the windows, of which it will use for its escape a greater or less height depending upon the value of the output. This gives eighty liquid veins, the identity of which depends entirely on the precision with which the windows have been constructed. One of the veins is received in a gauged basin. The rest of the operation is evident.

The continuous-current generators also number three (Fig. 2). They are of the Thury six-pole type, and can each give 417 amperes with a potential difference of 600 volts. The field winding is compound.

The shunt winding includes a regulating rheostat worked by an automatic regulator which maintains constantly the potential difference at the switchboard. The two generators in service are coupled in series with a neutral wire.

The switchboard of the generators is composed of the apparatus generally employed in the installations of electric traction and a few other necessities required by the series operation of the generators.

The middle or neutral bus-bar of the switchboard is directly connected to the rails, which fill the rôle of return conductor, by means of a copper cable of 125 square millimetres section. This connection is made at Drogeaux.

From the bus-bars of the switchboard leave three groups of two feeders which feed the overhead line. Consequently there are three feeding points situated where the consumption of current is the greatest. These points, with their corresponding voltage losses, are as follows: Grenoble, 360 volts; Les Drogeaux, 150 volts; Chapareillan, 225 volts.

To compensate automatically for this loss each of the feeders passes through a boosting set group composed of a motor and two generators giving the necessary extra voltage.

The motors of these sets are connected to the outside bus-bars of the switchboard and receive 1,200 volts. They are wound with compound field which causes them to revolve at a uniform speed whatever the work they have to furnish. These motors are naturally of varying size, according to the pressure which the generators should give.

The group for Grenoble feeders, which is the most important (360 volts), is composed of a motor driving two generators, together about eighty horse-power (third group to the right of the photograph, Fig. 2).

The group at Chapareillan (second in Fig. 2) is composed of a motor driving two generators of four poles and raises the pressure 225 volts (about fifty-six horse-power).

The last group (first to the right, Fig. 2) is that of Drogeaux (150 volts) and consists of a motor and two generators (about forty horse-power).

The boosting generators, which are driven by means of a Raffard elastic coupling by the motors, revolve therefore, also, at a uniform speed. These generators are series wound. The elevation of the potential which they produce is consequently a function of the current which traverses them, the field varying proportionally to the current between certain limits.

Before being connected to the contact line the supply feeders traverse a second distributing switchboard, called the boosting switchboard. This switchboard contains the metres and apparatus necessary to ensure the perfect working of the installation. Among other protective devices the overload circuit-breakers placed on the feeders protect the over-voltage generators from an excessive overload or accidental short-circuits which might occur. Each booster has on the extremity of its axle an apparatus for tripping the circuit-breaker if the direction of rotation be reversed, thus automatically short-circuiting the armatures of the boosting generators should the motor be injured.

Automatic lightning arresters, system Thury, protect the apparatus of the station from atmospheric discharges.

Fig. 3 shows the general scheme of the distribution.

The supply line leaves the station of Lancey, crosses the railroad from

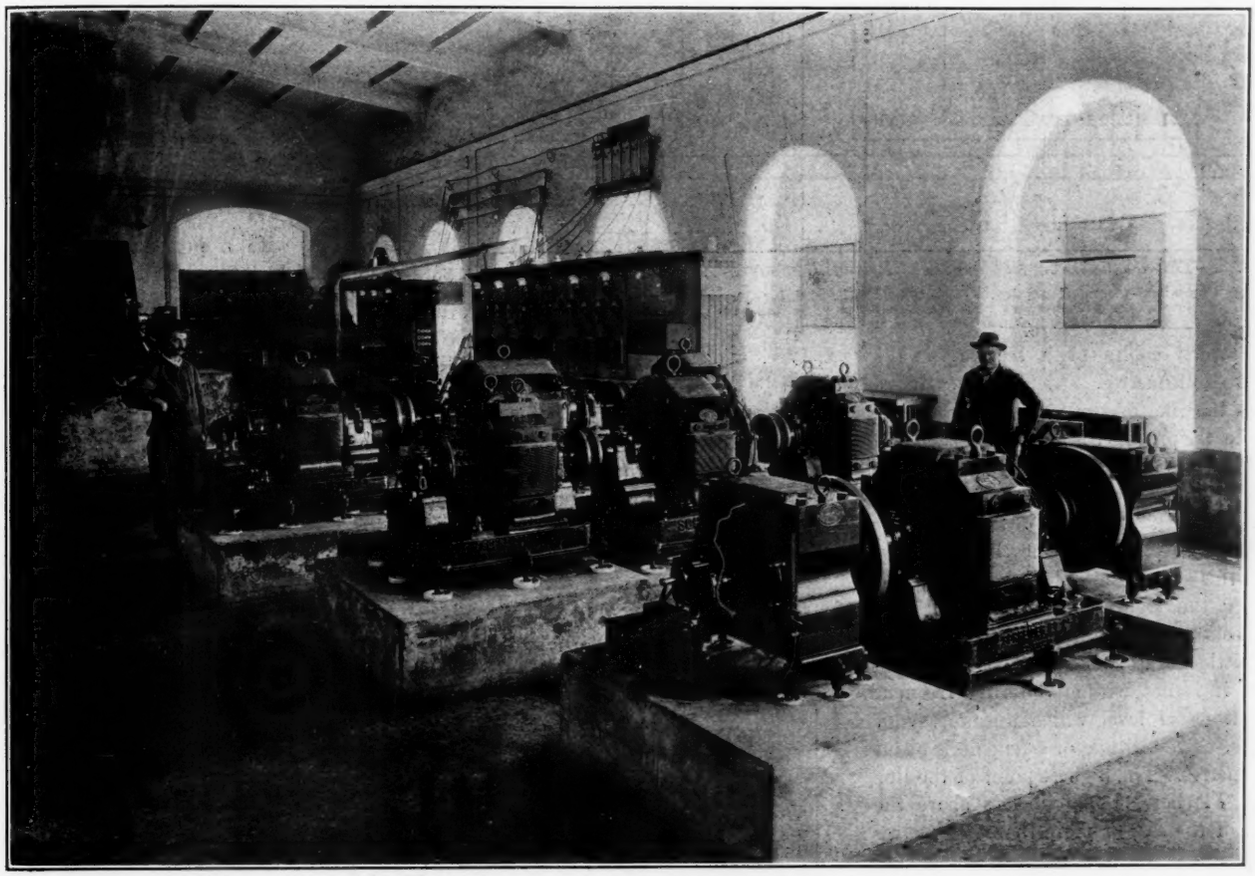

FIG. 2.—THE CONTINUOUS-CURRENT GENERATORS FEEDING THE TRAMWAY LINE BETWEEN GRENOBLE AND CHAPAREILLAN, FRANCE.

Grenoble to Chambery on a foot bridge specially constructed for this end and crosses the Isère, which at this spot has a width of about 125 metres. It is composed of six conductors of bare red copper of a section varying from 124 square millimetres to 65 square millimetres and

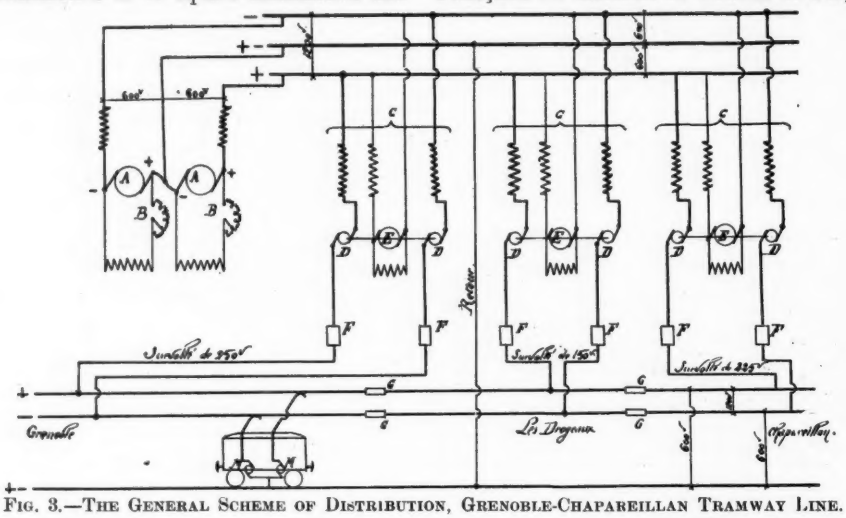

FIG. 3.—THE GENERAL SCHEME OF DISTRIBUTION, GRENOBLE-CHAPAREILLAN TRAMWAY LINE.

A—Compound-Wound Generator. *B*—Automatic Rheostat for Generator Field Regulation. *C*—Boosting Group. *D*—Over-Voltage Generators. *E*—Compound-Wound Motors with Over-Boosting Generators. *F*—Overload Circuit-Breakers. *G*—Section Insulator. *M*—Car Motor.

the return cables of a section of 125 square millimetres. At Drogeaux it rejoins the line of the tramway.

The telephonic line connecting all the depots and stations to the Lancey station follows this same route.

The track starting from Grenoble crosses the Isère River shortly after leaving this town, and winds along following the right side of the river. It connects with several little villages with but little work of note on the way. However, it is not without offering frequent variations of level which are worthy of notice. The altitude of Grenoble is about 212 metres. The highest point of the line is at Flachere, 423.86 metres above the level of the sea, or more than 200 metres difference in the grade. It is before and after this station of La Flachere, between this village and that of Tounex, on the one hand, and Barraux on the other, that a few of the most considerable grades of thirty-six and forty per cent are to be found.

The overhead line consists of two hardened copper wires, diameter nine millimetres, at a distance from each other of seventy centimetres. It is supported by metal bracket poles or by span wires anchored on the two sides of the line. Four overhead conductors have been laid at the crossing of the road and at the biggest stations in order to allow the cars to be easily stored (Fig. 4).

The track is constructed with grooved rails weighing forty kilogrammes per metre, and outside the town with (patin) T-rails of twenty-five kilogrammes to the metre. The gauge of the track is one metre. Bonds were of course used.

Cars—The motor cars and the trail cars were constructed by the Compagnie Française du Material de Chemin de Fer, at Ivry, and the equipments were furnished by Messrs. Schneider & Company, of Le Creusot.

The motor cars are of the ordinary tramway type with the central aisle having two axles and equipped with two motors. They can carry thirty-six persons, and their empty weight is 9.2 tons.

Each motor car is furnished with two four-pole Thury motors of thirty-five horse-power. These are coupled in series between the outside wires and the middle point connected to the earth. In other respects they are independent. The motors therefore always work at a tension of 1,200 volts.

The starting gear with its resistance is placed on the roof of the car and is worked from the conductor's platform by changeable hand-wheels. The cars can be worked from either end, thus avoiding the necessity of turn-tables. The conductor has only to take with him his controller hand-wheel. In attaching it he determines automatically direction of rotation of the motors. Between the motors and the axis of the car is a gear to reduce the number of revolutions.

The trains, composed of three cars, are furnished with electromagnetic hand-brakes which are applied to the motor cars and trailer cars. These brakes can be supplied with the line current, and also with the short-circuit current of the motors working as generators.

The passenger cars are lighted and heated electrically. Current, however, is only used from one side of the system.

The current from the overhead line is taken by two trolleys with interchangeable bows which are pressed against the overhead line with a pressure of ten kilogrammes.

The installation is able to maintain a simultaneous operation of nine trains of twenty-nine tons; eight trains for passengers and one for freight.

The cars of this railroad are composed of a proportionate number of passenger cars, several types of merchandise cars and combination cars. The financial results obtained in this first month are more than satisfactory, and better still is hoped for the future.

And the engineers at the recent "Houille blanch" convention, held at Grenoble, have once again had the opportunity of realizing that the utilization of hydraulic power to produce electric energy for traction should render considerable service in solving, or at least facilitating, certain problems of parochial and interparochial communication which would otherwise be very difficult to solve.

FIG. 4.—SHOWING OVERHEAD LINE CONSTRUCTION, GRENOBLE-CHAPAREILLAN TRAMWAY LINE.

HIGH TEMPERATURE ELECTROCHEMISTRY—NOTES ON EXPERIMENTAL AND TECHNICAL ELECTRIC FURNACES—III.

BY R. S. HUTTON AND J. E. PETAVEL.

Nitric Acid[1]—The fascination of the direct synthesis of an important chemical compound has for long directed attention to the production of nitric acid from the nitrogen and oxygen of the air. The research of Rayleigh and Ramsey, on the isolation of argon, followed by the important British association address delivered by Crookes in 1898, helped to emphasize the importance of this subject. The careful work carried out by McDougall and Howles, which has not received the attention it deserves, was more particularly directed to a study of the efficiency of this process. By employing an alternating high-tension arc in air they succeeded, by a study of the necessary conditions, in obtaining a yield of 300 grammes HNO_3 per twelve horse-power-hours, in this way combining fifty-one per cent of the air passed through their apparatus, while with a mixture of two volumes of oxygen to one volume of nitrogen the yield rose to 590 grammes per twelve horse-power-hours. In most of their experiments they used a transformer giving 8,000 volts. The work of Bradley and Lovejoy, at Niagara, has given more favorable results from an economical point of view. A considerable amount of preliminary work pointed out the advantage of the direct current, and the apparatus now working employs a 10,000-volt, continuous-current dynamo. The negative pole of the dynamo is connected to an axis carrying six radial arms, the positive poles being placed round the periphery of an iron cylinder which forms the combustion chamber. A choking coil is placed in each circuit. The actual apparatus comprises twenty-three such stars fixed one above the other on the same vertical axis, which revolves at the rate of 500 revolutions per minute, forming and breaking 414,000 arcs per minute. The chief function of this rotation is the rapid cooling down of the products of the combustion, which, if allowed to remain under the heating influence of the arc, would dissociate. For the same reason a rapid flow of air has been adopted, so that the issuing gases only contain about two to three per cent oxides of nitrogen. The yield obtained is one pound nitric acid per seven horse-power-hours. The process is considered to have already passed the experimental stage, and at the present time steps are being taken to start it on a commercial scale.

Fused Alumina—We have already mentioned the method of Hall for purifying bauxite by fusion in the electric furnace in presence of carbon or other reducing material. Our present consideration, however, is the manufacture of an artificial abrasive by the direct treatment of bauxite. The only method, so far as is known, in actual operation is that patented by Jacobs, which is now being employed at Niagara Falls, by the Norton Emery Wheel Company, for long known as important manufacturers of abrasive articles of natural corundum. It has been found that the electric furnace product possesses advantages over the best grades of natural material. The bauxite is first thoroughly calcined in ordinary furnaces, and is then heated to fusion in an arc furnace. The plant at present in use, which is about to be further extended, employs some 500 horse-power and produces daily from four to five tons of fused alumina, called "alundum," to distinguish it from corundum. The material exhibits at times considerable crystalline formations.[1]

Baryta—This material is being prepared at Niagara by the United Barium Company, Barytes ($BaSO_4$), together with some reducing material, being treated in the electric furnace. The reaction which first takes place is as follows:

$$4BaSO_4 + 4C = BaS + 2BaSO_4 + 4CO.$$

The barium sulphide then reacting with the sulphate to give anhydrous baryta.

$$BaS + 3BaSO_4 = 4BaO + 4SO_2$$

In practice 500-kilowatt tapping furnaces are in use, which yield a mixture of oxide and sulphide. These are separated easily in aqueous solution yielding a very good quality barium hydrate. The sulphide can afterward be carbonated or otherwise worked up.[2]

Carbon Bisulphide—As we have pointed out previously, the electric furnace is usually employed for producing chemical reactions which require temperature otherwise unattainable. In the manufacture of carbon bisulphide the advantage of electric heating lies, however, in the fact that a more perfect control of the furnace temperature can be thus attained, the temperature required being very low. The method invented by E. R. Taylor for producing this substance consists in the direct treatment in the electric furnace of charcoal and sulphur. The manufacture has been carried out for some time at Penn Yan, N. Y., the daily output being some 10,000 pounds. The furnaces are decidedly the largest at present in use in any electrochemical works, being some forty feet high by sixteen feet diameter. The sulphur is fed in continuously so as to rise from below the electrodes where it comes in contact with coke which forms a resistance bridge between the carbons, in this way becoming vaporized and brought into contact with the charcoal which fills the rest of the tower; combination takes place, and the CS_2 produced is led off and condensed. By the application of this process a very considerable cheapening in the cost of production has been effected.

Steel—The application of the electric furnace to the melting of steel, which was one of the first problems worked upon the Siemens, has been revived during the last few years in many different forms. The proposals, which not only include the manufacture of steel from pig iron, but also the direct production by electric smelting of the ore, have led to the design of many special types of furnaces.

De Laval[1] invented an ingenious furnace for making steel in which the metal was melted by bringing it in contact with fused oxide of iron heated electrically by resistance. This method is reported to have been tried at Trollhättan, in Sweden, on a large scale, but to have been a financial failure.

Stassano's[2] furnace was in design somewhat similar to the blast furnace, the necessary heat being produced by the electric arc. A company was formed to work this process in Italy, but is said to have since ceased operations. One ton of metal was produced per 3,000 horse-power-hours.

Harmet,[3] of the "Fonderies, Forges et Acieries," at St. Etienne, has worked out a method for treating iron ore in three stages, the carbon monoxide evolved by the reduction being partly used to heat the raw materials, while the reduced metal is transformed into steel in a separate electric furnace. Works are being erected at the present time for making use of this process.

(To be concluded.)

[1] McDougall and Howles, *Manch. Lit. and Phil*, vol. 44. part 4. No. 18, pp. 1-19. 1900; Bradley, *Electrical World and Engineer*, vol. 40, p. 150, 1902; Rayleigh, *Journ. Chemical Society*, vol. 71, p. 181, 1897.

[1] Jacobs, *U. S. Patent*, Gintl, *Zeitschr. für angew. Chemie*, p. 1,173, 1901; Hassiacher, *German Patent*, 85,021 of 1896.

[2] Jacobs, *Journ. Soc. Chem. Ind.*, vol. 21, p. 391; Limb, *Eng. Patent* No. 7,282, 1899.

[1] *Jahrbuch der Elektrochemie*, vol. 1, p. 123, 1894.

[2] *Jahrbuch der Elektrochemie*, vol. 6, p. 320, 1899; *Zeitschr für Elektrochemie*, vol. 8, pp. 61, 852, 1902; *Journ. Soc. Chem. Industry*, vol. 20, p. 816, 1902.

[3] Harmet, *Étude sur l'Electrometallurgie du Fer*, I. and II. Cf. also *Electrochemist and Metallurgist*, vol. 2, p. 18, 1902; *Zeitschr. für Electrochemie*, vol. 8, p. 852, 1902.

Pole Lines for Power Transmission.

By Alton D. Adams.

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LONG transmission lines should follow the most direct routes between generating and substations as far as practicable. The number of poles, cross-arms and insulators increases directly with the length of line and the weight of conductors with the square of that length, other factors remaining equal. Every material deviation from a straight line must therefore be paid for at a rather high rate.

Distribution lines necessarily follow the public streets in order to reach consumers, but the saving of the cost of a private right of way and ease of access are the main considerations which tend to keep transmission lines on streets and highways. Except in very rough or swampy country the difficulty of access to a pole line on a private right of way is not a serious matter and should be given but little weight. The cost of a private right of way may be more important and should be compared with the additional cost of the pole line and conductors if erected on the public highway. In this additional cost should be included any items for paving about the poles, extra pins, insulators and guys made necessary by frequent turns in the highway, and the sums that may be required to secure the necessary franchises. There is also the possible contingency of future legislation as to the voltage that may be maintained on wires located over public streets. These considerations taken together give a strong tendency to the location of long transmission lines on private rights of way, especially where the amount of power involved is great and the voltage very high.

A transmission line 80.3 miles in length recently erected between Rochester and Pelham, N. H., by way of Portsmouth, to feed an electric railway system, operates at 13,200 volts and is mainly located on private rights of way. Deeds conveying the easements for this right of way provide that all trees or branches within one rod on either side of the line may be cut away. The transmission line between Niagara Falls and Buffalo, about twenty-five miles long and operating at 22,000 volts, is largely on a private way thirty feet wide.

For the transmission between Cañon Ferry and Butte, a distance of sixty-five miles at 50,000 volts, the line is mainly located on a private way. Between Colgate and Oakland the transmission line, 142 miles long and operated at 40,000 volts, is mostly on private way, and this is also true of the greater part of the other high-pressure lines in California. These private rights of way range from fifty to several hundred feet wide, it being necessary in forests to cut down all trees that are tall enough to fall onto the wires.

In some cases of transmission at very high voltage two independent pole lines are erected and one or more circuits are then run on each set of poles. This construction has been followed on the transmission line between Niagara Falls and Buffalo, Cañon Ferry and Butte, Welland Canal and Hamilton, and between Colgate and Oakland. Such double pole lines are more usually located on the same right of way, this being true of the Niagara Falls, Cañon Ferry and Colgate systems, but this is not always the case. In the Hamilton system the two lines of poles, one thirty-five miles and the other thirty-seven miles in length, are located several miles apart. The two sets of poles on the Buffalo line are less than thirty feet, on the Colgate line are twenty-five feet, and on the Cañon Ferry line are forty feet apart.

The main reasons for the use of two pole lines instead of one are the probability that an arc started on one circuit will be communicated to another on the same poles, and the greater ease and safety of repairs when each circuit is on a separate line of poles. On each pole line of the Cañon Ferry transmission, and also on each pole line of the Colgate transmission, there is only one three-wire circuit. The use of two independent circuits in each of these transmissions is due to the desire to limit the inductance of the lines and the concentration of current in the outer layers of each conductor. These troubles are not so serious as to make the multiplication of circuits highly necessary in most cases in order to reduce the size of each conductor. Thus on the Cañon Ferry line each wire of the two circuits has a cross-section of only 106,500 circular mils, and on the Colgate line one circuit is of 133,225 circular mils wire and the other circuit is of 211,600 circular mils cable. In contrast with these figures the line of the Standard Electric Company between Electra and Mission, San Jose, a distance of ninety-nine miles, is made up of only three conductors, each being an aluminum cable of 471,034 circular mils section. Inductance increases with the frequency of the current in a conductor, but in each of the three systems just considered the frequency is sixty cycles per second.

The use of one circuit of larger wire instead of two circuits of smaller wire has the obvious advantage of greater mechanical strength in each conductor, saves the cost of one pole line and of the erection of the second circuit. With voltages above 40,000 to 50,000 on long transmission lines there is a large loss of energy by leakage directly through the air from wire to wire. To keep this loss within desirable limits it is necessary to give each wire of a circuit a greater distance from the others of the same circuit than can be had if all the wires of each circuit are mounted on one line of poles. If there is only one three-wire circuit to be provided for, three lines of rather small poles may be set with any desired distances between the lines so that the leakage through the air with one wire on each pole will be reduced to a negligible quantity. On a line built in this way it would be practically impossible for an arc to start between the wires by any of the usual means.

Distances from pole to pole in the same line vary somewhat with the number, size and material of the conductors to be carried. On ordinary construction in a straight line poles are often spaced from 100 to 110 feet apart; that is, about fifty poles per mile. On curves and near corners the spacing of poles should be shorter. Poles for the 80.3 miles, mentioned in New Hampshire, are regularly located 100 feet apart. Of the two pole lines between Niagara Falls and Buffalo, the older was designed to carry twelve copper cables of 350,000 circular mils each, and its poles were spaced only seventy-five feet apart. The newer line is designed to carry six aluminum cables of 300,000 circular mils each and its poles are 112 feet apart. Poles in each of the lines between Cañon Ferry and Butte are regularly spaced 110 feet apart and each pole carries three copper cables of 106,500 circular mils.

The two 142-mile lines between Colgate and Oakland are each made up of

poles 132 feet apart, and one line of poles carries the three copper conductors, and the other line of poles the aluminum conductors already named. As aluminum wire has only one-half the weight of copper wire of equal conductivity, the length of span between poles carrying aluminum wire may be greater than that where copper is used, and has been more than 150 feet in some cases. Only a part of the strain on poles is due to the weight of wires carried, however, and any material increase in the usual length of span should be made only under very favorable conditions. Where a body of water must be crossed, a very long span, with special supports for the wires at each side, may be necessary. A case of this sort was met where the Colgate and Oakland line crosses the Carquinez Straits at a point where the waterway is 3,200 feet wide. It was necessary to have the lowest part of the cables across these straits at least 200 feet above the surface of the water so that vessels with the tallest masts can pass underneath. To secure the necessary elevation for the cables a steel tower was built on each bank of the straits at such a point that the distance between the points for cable support on the two towers is 4,427 feet apart. As the banks rise rapidly from the water level, one steel tower was given a height of only sixty-five feet, while the height of the other was made 225 feet. Between these two towers four steel cables were suspended, each cable being made up of nineteen strands of galvanized steel wire, having an outside diameter of seven-eighths inch and weighing 7,080 pounds for the span. The breaking strain of each cable is 98,000 pounds and it has the electrical conductivity of a No. 2 copper wire. The cables are simply supported on the towers by steel rollers, and the pull of each cable, amounting to twelve tons, is taken by an anchorage some distance behind each tower, where the cable terminates. Each anchorage consists of a large block of cement deeply embedded in the ground, and with anchor bolts running through it. Each cable is secured to its anchorage through a series of strain insulators, and the regular line cables of copper and aluminum are connected with the steel cables just outside of the shelter built over the strain insulators of each anchor. Steel cables were used for the long span across the straits because of the great tensile strength that could be had in that metal. This span is, no doubt, the longest and highest that has ever been erected for electrical transmission at high voltage.

It has been suggested in one instance that steel towers ninety feet high and 1,000 feet apart be substituted for pole lines and the wires strung from tower to tower. Such construction would increase the difficulty of insulation and would cost far more at the start than a line of wooden poles. It seems very doubtful whether a lower maintenance and depreciation rate for the steel towers would offset their disadvantages compared with poles. Pole lines should be staked out with a transit, and the same instrument can be used to give a perpendicular position to each pole and bring it into line. Wooden poles are used almost exclusively for high-voltage transmission lines. Iron poles would make it unsafe to work on any circuit carried by them when another circuit on the same poles was transmitting current at high voltage. With iron poles a defective insulator would be apt to lead to the destruction of the conductors at that point through continuous arcing on to the iron.

The kinds of wood used for poles vary in different sections of the country. In New England chestnut poles are a favorite and were used on the 80.3 miles of transmission line mentioned in New Hampshire. Cedar poles are used to some extent in nearly all parts of the country, including Canada. Spruce and pine poles are employed to some extent, especially in lengths of more than fifty feet. In the Rocky Mountain region and in California round cedar poles from the forests of Oregon, Washington and Idaho are much used. Sawed redwood poles from the trunks of large trees were erected on the 145-mile line between Electra power-house and San Francisco. For the Colgate and Oakland line, Oregon cedar poles were selected, and the transmission between Cañon Ferry and Butte was carried out with cedar poles from Idaho. For transmission circuits it is far more important at most points to have poles very strong rather than very long. Where wires or obstructions must be crossed by the high-voltage circuits the poles should be long enough to carry these circuits well above everything else. In the open country, where no obstructions are to be avoided, it does not pay to use poles with a length greater than thirty-five feet.

Short poles offer less surface to the wind, the length of the lever through which wind pressure acts to break the pole at the ground decreases with the length of pole, and the shorter the poles the smaller is the strain on struts and guy wires. If poles are only thirty or thirty-five feet long, they may be very large in diameter with excessive cost. As a rule, no pole should be used with a top less than seven inches in diameter, and a pole with this top should not be required to carry more than three No. 2 wires. A pole with seven or eight-inch top and thirty feet long should measure not less than twelve inches in diameter at the butt. For longer poles the diameters at the butt should increase up to at least eighteen inches for a round pole sixty feet long.

In the New Hampshire transmission above named the standard length of poles is thirty-five feet. On the line between Cañon Ferry and Butte the poles range from thirty-five to ninety feet in length. The round cedar poles used in the Colgate and Oakland line range from twenty-five to sixty feet in length, from eight to twelve inches diameter at the top and from twelve to eighteen inches diameter at the butt. On the line between Electra and San Francisco the square-sawed redwood poles are reported to have the following dimensions, by a paper read at the annual convention of Edison Illuminating Companies in 1902.

Height, Feet.	Top, Inches.	Butt, Inches.	Depth in Ground.
35	7 × 7	12 × 12	5.5
40	8 × 8	13½ × 13½	6
45	9 × 9	15 × 15	6.5
50	10 × 10	16 × 16	7
60	11 × 11	17 × 17	8

The relative dimensions of these poles are of especial interest because, being sawed from the trunks of large trees, they could have any desired measurements at the tops and butts. These poles, over the greater part of the line, carried the three aluminum cables of 471,034 circular mils each, previously mentioned. Depth to which poles are set in the ground ranges from about five feet for twenty-five or thirty-foot poles to eight feet for poles sixty feet long. In locations where the soil is very soft or where poles must resist heavy strains the stability of each pole may be much increased by digging the hole two feet or more larger in diameter than the butt of the pole, and then filling in one foot of good cement concrete—one part, by measure, of Portland cement, three of sand and five of broken stone—all around the butt of the pole after it is in the hole. The butts of poles up to a point one foot or more above the ground line are frequently treated with hot tar, pitch, asphalt or carbolineum before the poles are erected, and in Salt Lake City salt is said to be used around pole butts after they are in the hole.

(To be continued.)

A Review of Electrical Engineering in Europe During 1902.

By Our Special Correspondent.

THOSE readers of the ELECTRICAL REVIEW who have followed at all carefully the regular news letters which have appeared in its columns relating to electrical matters in Great Britain and Europe generally will be somewhat familiar with the more important details of electrical engineering interest in those parts. It is now, therefore, only proposed to pass in review somewhat non-technically what has happened during the past twelve months.

THE COMMERCIAL ASPECT—GERMANY.

Dealing first of all with the commercial side of the industry, the one great outstanding feature has been the continuance of the trade depression in Germany, though in a somewhat modified form, where, in spite of the home trade being in a fairly flourishing condition, the market value of electrical manufacturing undertakings has diminished enormously. A typical instance of what was taking place is the fact that the loss in the value of the shares of twenty-one electrical trading concerns, whose combined capitals amounted to some £22,250,000 sterling, was computed at £13,500,000 between January 1, 1899, and October, 1901, and it was the after-effects of such an unpleasant financial disaster as this that have been mostly keenly felt during 1902. What the results of the year's working just closed will be remain to be seen, but the chief concerns have fallen so sadly away during the past few years that they are severely handicapped at any rate for a year or two under the best conditions. The Consul-General in Frankfort has shown that since the year 1900 five such important firms as the Helios Company, the Cologne Electric Works, Kummer & Company, and Schuckert & Company have paid no dividends whatever.

THE CAUSE OF DEPRESSION.

The primary cause of all these financial difficulties would appear to have been very much the same as that which stifled electrical enterprise in Great Britain some years back, *viz.*, a want of confidence on the part of the public consequent on the flotation of numerous joint stock concerns which, during the boom from 1898 to 1900 in Germany, invested and lost large sums of money in foreign undertakings. This is the opinion of a man on the spot and is probably not far wide of the mark, as British pioneers can amply testify.

A LARGE AMOUNT OF EXPORT TRADE IN GREAT BRITAIN.

Happily the remainder of the chief countries of Europe are not laboring under the weight of any such millstone as this, and in general terms, prospects are good, especially in Great Britain, where a large amount of export trade has been done principally with the colonies, which seem to have a penchant for the employment of consulting engineers with the result that a fair percentage of the orders are placed in Great Britain. On the other hand, the leading types of engines manufactured in Europe, outside of Great Britain, such as the Sulzer, find many customers in the United Kingdom, a notable instance being the Metropolitan Electric Supply Company at its Willesden works. The completion of the new large works of the British Westinghouse Company and the British Thomson-Houston Company at Manchester, England, has obviated the necessity of importing these firms' goods from America, and although American patterns and standards will doubtless prevail, the fact that British workmen must of necessity be employed in the manufacture of their machinery places the existence of these two concerns in Great Britain in quite a different light than heretofore.

TECHNICAL AND ENGINEERING APPLICATIONS.

Technically, a great deal has been accomplished. In Great Britain giant strides have been made in the application of electricity to locomotion, not the least important being the inability of the steam railways in many parts to withstand the competition of the existing electric tramways. In the northeast of England the local railway company has, perforce, been obliged, on its purely local and short-distance lines, to consider the possibilities of electric traction, and tenders for the conversion of a fair mileage are now under consideration. And this story may be applied to Liverpool, Glasgow and London itself where, in the next session of Parliament, two of the main steam railway companies of the country are seeking powers to use electric traction on their lines. The success of interurban electric tramways over comparatively short distances in all parts of the continent has been such that the short-distance traffic upon the steam railways serving the same districts has been sadly mutilated, and present tendencies appear to point to a speedy adoption of electricity as the motive power in order to obtain the higher speeds and lower fares necessary to compete with the tramways. There have been many notable examples during the year of what the future is likely to bring forth. In England, in addition to what has been mentioned above, there has been a steady progress made by the Underground Electric Railway Company in its scheme of conversion to electrical working of the Inner Circle and confluent lines under the guiding hand of Mr. Yerkes.

ITALIAN RAILWAY UNDERTAKINGS.

In Italy a similar state of affairs existed in connection with the Adriatica and Mediterranean railway companies which, together, own some eighty per cent of the railways in that country, and the competition from electric tramways has been felt in the same degree, the principles remaining the same, although the conditions are naturally somewhat different. The result has been, after a deal of consideration, the conversion of a large mileage to electrical working, and the increase in the number of trains which it is now able to run each way upon those sections already converted is sufficient commentary upon the efficiency of electric traction. In Italy, also, is the courageous attempt on the part of Messrs. Ganz to introduce the high-tension, three-phase system on the Valtellina Railway, which, so far, is working satisfactorily.

PARIS AND BERLIN TRACTION.

Alike with London, Paris and Berlin both have made improvements in their underground railway service, and in both these cities electric traction continues to operate to the detriment of other modes of traction. At the time of the opening of the Paris Metropolitan Railway (which it was intended to work in two separate half circles) only one of these was in operation, but the year 1902 has seen the other half put into service, with extremely satisfactory results. In Berlin there is, of course, an elevated railway, and an underground shallow subway railway is to be constructed, both electric. On the former, advantage has been taken of the experience gained in America and England to adopt, as the Germans think is right, a lighter rail than has usually been adopted in these latter countries for roads operated electrically, but the wisdom of this is seriously questioned. The shallow surface line is, as yet, in what

may be termed the projected stage. A tube railway is also contemplated in Berlin. On the Wannsee Railway, also, experiments have been made in running some of the trains electrically, but possibly on account of the insufficient character of these more complete trials have been decided upon. Still dwelling upon Berlin it is to be noted that the last horse car disappeared from the streets during the year, in which there are now some 865 kilometres of electric lines. In other cities, beyond the natural extension of the trolley system, no important developments have taken place. Among other towns where the whole tramway system is now worked electrically is Turin, Prague (Austria), etc., and the value of through express lines, with no intermediate stopping places, would seem to appeal to traction promoters, as since the sanction by the British Parliament of the Liverpool-Manchester express railway serious proposals are being made for such a service between Brussels and Antwerp, and Naples and Rome. In St. Petersburg, too, the capital of a country where the development of Nihilistic plots would seem to meet with greater favor than industrial expansion, preference has recently been given to an American scheme of electric tramways. Reverting to Germany once more mention need only be made of the high-speed electric traction experiments made on the Berlin-Zossen military railway, and of Messrs. Siemens & Halske's 10,000-volt locomotive, both of which have been dealt with in the ELECTRICAL REVIEW.

SWITZERLAND.

In Switzerland the transformation of the whole of their railways to a standard gauge electric system is under serious discussion, and the chiefs of the leading engineering electrical firms are taking an important interest in the matter.

ELECTRIC LIGHTING MATTERS.

In electric lighting matters, the industry has reached a condition of standardization only to be expected after so many years' use and consideration of the multifarious problems involved. All that has happened is, to all intents and purposes, an inevitable extension of the recognized practice obtaining in the various countries throughout the Continent. Thus, for instance, in Great Britain there has been a large number of small electric lighting stations put into service upon the usual three and two-wire system at 220 volts or so, and the same thing applies throughout. The introduction of new details, such as lamps, instruments, etc., would take up too much space to go into here, but perhaps notice ought to be taken of M. Thury's 25,000-volt, continuous-current dynamo.

ELECTRIC POWER TRANSMISSION.

Coming to electric power transmission, one has a much wider field for discussion, and here England, France and Switzerland take large shares. As a matter of fact, more could be said concerning water-power transmission, not from the point of view of what has been done as to what could be done with the natural sources available. But in this, as in all matters, finance plays an influential part and a steadily maintained progress is all that may be expected. In Switzerland and Italy the number of small and large water-power installations, both traction and lighting, as well as industrial, has resulted in those countries, in Europe, being regarded as the very criterion of cheap production, especially when being held in the limelight of comparison between one country and another; but that this is more or less a fallacy is being demonstrated every year. An important installation of this description is in the Department of Aude, in France, in which, although the network at present consists of some 400 kilometres of high-tension, three-phase lines, this will eventually extend to 600 kilometres, and serve an area consisting of a population of 150,000 people. The fall utilized on the River Aude is 100 metres high. The whole of the equipment of this installation is purely Continental, no British machinery being employed. There are numerous possibilities for water-power transmission in France, especially in the South, but the development of it on any extensive scale has not yet been begun, although there are a large number of industrial works obtaining their power in this way. Speaking for the moment, generally, a French engineer has calculated that the horse-power running to waste in French rivers reaches millions, and only something over 200,000 horse-power in use. Similarly, in Italy even, only 300,000 horse-power has been utilized out of an estimated total, by the same authority, of nearly 3,000,000 horse-power. Of course, all these are merely theoretical figures, but they are of much practical importance when considered in conjunction with the successful working of such large installations as those at Rheinfelden, etc. In Great Britain the problems of power distribution have to be viewed from a different standpoint, inasmuch as the possibility of utilizing water power to any large extent is the exception rather than the rule. Nevertheless, it seems exceptional that with the examples offered of adapting the natural resources of other countries to this purpose, the idea of building large generating stations in the centres of the collieries districts and distributing, wholesale, electricity in this wise should not have been put into practical shape until a few years ago, when the first of the huge power schemes was sanctioned by Parliament. Fifteen such schemes have now been authorized, and two are supplying on a large scale. Another scheme for which Parliamentary powers will be sought this year affects the Welsh hills, and is being fostered, among others, by Sir William Preece. This is one of the few spots in Great Britain where water power to any appreciable extent is available, and already there is a very small installation in which overhead wires are employed in this neighborhood. This mention of overhead wires revives an old standing complaint in Great Britain, where the powers that be have always proved very difficult of conversion to the view that at average pressures and in open country these are perfectly harmless. However, there is now a disposition to relax this tendency, and in connection with these power schemes great satisfaction is felt thereat. In another direction, this section of the industry has proved a great success in connection with the haulage on the Brussels-Charleroi canal, an application of electric power of which there are not too many instances on the side. Parliamentary powers, however, were granted for this on a canal in the south of England this year, and this particular canal, which will run for part of its journey through tunnel, will have these lighted by electricity.

WATER-POWER PROJECTS.

Apropos of the conversion of the Swiss railways to electric traction and the utilization of water power for the purpose, mentioned earlier in this article, a Zurich engineer has given great attention to this and I take some of the following from his published figures: The five principal Swiss railways would require some 30,000 horse-power per day, and to effect the whole of the purpose in view, 60,000 horse-power would need to be developed. As to whether the available water power would meet this demand, he cites the fact that at present there are under construction or in operation over twenty such installations, ranging from 20,000 horse-power to 1,000 horse-power. The matter

is still under consideration, but the Oerlikon Company has applied for a concession to construct an experimental line. Altogether, progress in the department of electrical power transmission in Great Britain and Europe has been well maintained against several adverse influences, such as legislation in Great Britain, and industrial depression in Germany, for instance.

THE TELEGRAPH AND TELEPHONE.

Telegraphy and telephony, with a history dating back later than any other of the applications of electricity, have, for many years past, confined their progress mainly to increase of speed in signaling, on the one hand, and to long-distance speech on the other. As regards telephony in Great Britain, the turn of events occasioned by the Telegraph Act of 1899 is now of world-wide fame, and the important part played by the National Telephone Company has been in no wise minimized as a consequence. In fact, this particular piece of legislative machinery has served to emphasize the strength of the company's position, as exemplified by the fiasco which has attended the effort at operating a muncipal exchange in competition with the National company in Tunbridge Wells, where a weak-kneed policy has resulted in the company buying up its competitor. Other municipalities, however, of greater political importance than Tunbridge Wells are in a better position for a fight, and so far Glasgow holds its own. A new competitive exchange has been opened during the year at Portsmouth, and others will shortly follow at Brighton, Swansea, etc. In Paris a new system has been put into operation. Here, where, as in practically all the countries in Europe except Great Britain, the whole of the telephone business is under the administration of the government, several important improvements over the old system have been effected, consisting chiefly of the introduction of automatic calling and clearing signals, the elimination of the multiple jacks on the subscribers' or local section of the switchboard, and the reduction of the junction line operators.

IMPROVEMENTS IN LONG-DISTANCE COMMUNICATION.

Of the improvements in telephonic communication between the different countries, the London-Brussels cable, which it is hoped will be ultimately extended to Berlin, has been on the tapis for some considerable time. At the time of writing, the whole cable is laid, but some details have yet to be concluded concerning the agreements between the two countries, and it is not expected that the line will be opened before March, 1903. Another new telegraph line to Germany from Great Britain has been completed, and a direct line has been opened between Liverpool and Paris, while negotiations for the extension of the Anglo-French telephone service between provincial towns in both countries have been brought to a successful issue. Arrangements have also been made between the Russian and German postal authorities to connect Berlin and St. Petersburg by telephone, a distance of 1,000 miles, and this telephone will soon be in working order, and in like manner all the main towns throughout the entire continent are being linked up. The local services are being well looked after, among other important items being the increased popularity of the Swedish telephone service where a £3 service, plus a charge for the cost of connection, is given, and the resolution of the Austrian Government to spend some £800,000 on extensions. In Berlin the number of telephonic apparatus in use has reached and passed 60,000 during 1902 in a city having a population of something over 2,000,000 souls, and as a final indication of the growth of telephony in Europe the following numbers of public telephone stations in Germany may be quoted: Berlin, 51,561; Dresden, 8,914; Leipzig, 8,725; Cologne, 7,484; Hamburg, 20,823, on April 1 last (the last available figures). Wireless telephony, still in its infantile stage, is being developed by one or two Continental pure scientists, but as anything else than valuable scientific work, the results have been of little importance.

German high-speed typographic, telegraphic experiments have been conducted by which it was computed that twenty officials could send 18,000 words an hour over a single wire. Of course the chief event as affecting Great Britain has been the opening of the Pacific cable, but as this is hardly a European event, pure and simple, I will say no more upon this. Gradually the various authorities are realizing that the extra expense incurred in laying underground telegraph and telephone lines is repaid by the consequent immunity from the breakdown attendant upon overhead wires, and a large increase in the underground systems both in Great Britain and Germany has taken place.

ELECTROCHEMISTRY.

Great Britain is notoriously vastly inferior to the other countries of the Continent of Europe, and, indeed, to America, in the manufacture of electrolytic alkali, etc., and although the solitary couple of works existent in the United Kingdom are going along satisfactorily from the financial point of view a bigger progress is being made in Germany and other countries. The Electrolytic Alkali Company, whose works have been described and illustrated in the ELECTRICAL REVIEW, is increasing the capacity of the works, and also its capital, and the Castner-Kellner Company expects, when the additions to its works are complete, to get somewhere near the tens of thousands of horse-power in output. But these works are very pigmy in comparison with the remainder of the Continent. The output from three of the German works more than trebles this, and in France the industry is characterized by the increasing number of such installations rather than by their individual magnitude. But throughout the Continent the demand seems well within the supply, and in that respect is scarcely comparable with the other branches of the industry.

PRESENT CONDITIONS AND PROSPECTS.

The present position and prospects of the electrical engineering profession on the Continent of Europe leave but little cause for complaint in view of the fact that in places it is quickly regaining its prestige after a setback inevitable to all booms. It is everywhere being demonstrated that electricity, as an adjunct to the facilitation of business and in the hundred and one useful spheres in which it has found an outlet in the United States rather more quickly than here, will eventually predominate, and the numerous barriers to its progress which have hitherto existed are being gradually broken down. In Great Britain, for instance, the use of electricity in mining has been somewhat retarded by reason of the fact that the government had no jurisdiction in the matter of regulations. But during the year a committee has been appointed to ensure the proper carrying out of mining installations, and the effect of this is reflected in the large amount of machinery which is now being installed in British mines. Similarly, the effect of the deputation on the part of the British Institution of Electrical Engineers has been to remove many objectionable and unreasonable prejudices on the part of the legislature, and inasmuch as, to a large extent, one country follows another in these matters the restraint under which Europe has heretofore existed is being slowly overcome, and ere long the same freedom of action will prevail which has, on this side at any rate, been so characteristic of the United States in the past.

A. WEBSTER.

London, December 31.

The Extensive Paris System of Conduit Electric Roads.

By Our Special Correspondent.

THE underground conduit road, which is now in operation in Paris, is no doubt the most extensive in Europe. A system of lateral conduit is used within the city limits which joins on to a short branch of trolley road extending to the suburbs. The line which has a total length of seven miles is operated in three sections; the first starts from the Place de la Bastille, and runs through the southern part of the city to the Montparnasse railway station. At this point commences the second section which crosses the Seine and has its terminus at the Place de l'Etoile. The remaining section, which is of more recent construction, runs from the latter point through the western part of the city to the Asnières Gate, where it connects with a trolley line which passes to the suburb of St. Oven. The trolley section occupies about a quarter of the total length of the system.

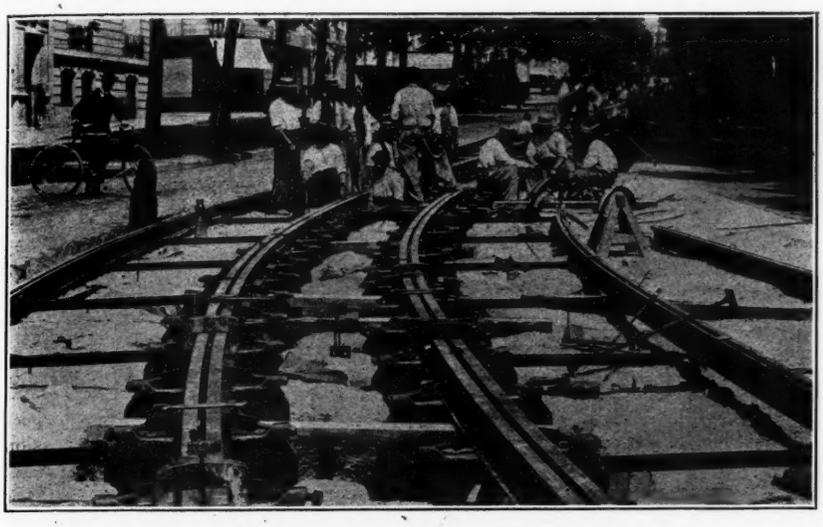
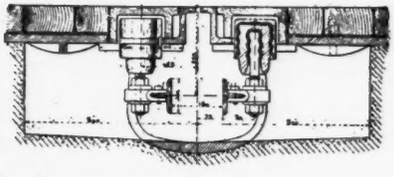


FIG. 1.—THE TRACK CONSTRUCTION, PARIS SYSTEM OF CONDUIT ELECTRIC ROADS.

FIG. 2.—TRACK ALMOST COMPLETED, PARIS SYSTEM OF CONDUIT ELECTRIC ROADS.

The construction of the underground conduit, which is used on these systems, differs in many respects from anything that has been installed hitherto. All the conduits formerly installed by the company were of the central type and laid in the middle of the track, having some analogy to that which is used on the conduit system of Washington. It was found impossible, however, to introduce the central conduit system in Paris on account of the wood paving which is used in the greater part of the streets. The excessive wear of the paving at the sides of the conduit rail soon causes this rail to project at the surface of the street, and thus become an obstacle to the circulation. The ordinary rail of the track has also this inconvenience, but in this case it is unavoidable. Owing to the difficulties arising from placing the conduit in the centre of the track a new arrangement was sought for, and it was decided to employ a system of lateral conduit, this to be laid along the track directly underneath the rolling rail which is supported upon it. This system, however, presented some disadvantages which had to be overcome. In the first place, the obstructions occurring in the grooves are of double importance, as the grooves not only give passage to the contact plow, but also to the flange of the wheel. As the conduit structure has to support the direct weight and the effort of the vehicle it must be of a heavy construction. Then the insulation of the contact plow is more difficult on account of the mud which is thrown upon it by the wheels. Another difficulty lies in the fact that it is impossible to make a switch in the lateral conduit which is entirely satisfactory. This last point is the most important. In fact the flanges of the wheels make it necessary to use a wide groove, and again the upper surface of the switch must be at the same level as



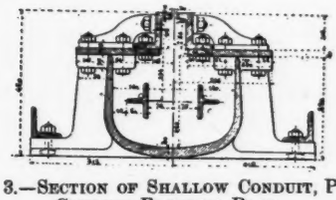


FIG. 3.—SECTION OF SHALLOW CONDUIT, PARIS CONDUIT ELECTRIC ROAD.

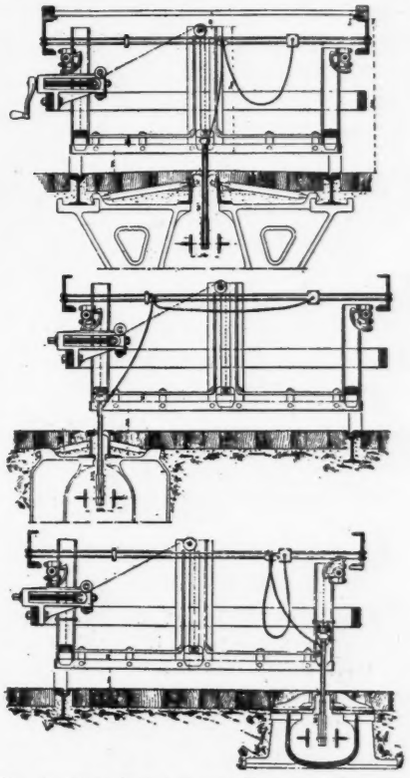


FIG. 4.—THE PLOW IN THE THREE DIFFERENT FORMS OF CONDUIT.

the top of the rail, contrary to what is required for a central conduit and must be strongly built, while possessing a considerable width at the points of intersection. Under these conditions a switch of the proper construction would require a groove as large as 1.8 to 2 inches at the extremity of the point. Such a width might be admissible in some European cities, but in Paris, where the traffic is mostly made up of light vehicles, it is to be avoided if possible. In the present system these difficulties have been overcome by the following construction. The two conduits are placed on the inner side of the track, and are carried by cast-iron supporting pieces spaced forty inches apart. The rails on the outer side of the track are maintained by cross-bars spaced six feet apart, and the two inner groove rails are maintained in like manner. The conducting bars and their supports are somewhat like those used on the Washington system. The construction of the conduit will be easily understood from the various photographs and diagrams.

The photograph (Fig. 1) further illustrates the track construction. The supports and the rails are first put in place and then the brace-pieces serve to regulate the whole and keep the rails properly spaced apart. The supports are solid cast-iron frames having an opening in the centre of the same section as the conduit. The rails are bolted to the flat top and are held in place by a side strap. After the supports have been put in place a series of sheet-iron forms is mounted in the intervals which have the same section as the conduit which is to be constructed. Around the forms is run a layer of cement which gives the conduit the form shown. The sheet-iron form is then withdrawn through the groove. By this simple method it is possible to lay 325 feet of double track per day. The engraving (Fig. 2) shows the appearance of the track when nearly completed at the terminus of one of the sctions at the Place de l'Etoile. Here the system becomes more complicated, and there are several switches and crossings. The construction of the switches is that which was adopted at Lyons and has given good results. The tongues of the switch are operated by a removable lever on the outside of the track. The switch levers are put back in place automatically by the passage of the contact plow and the effort necessary for their displacement is so slight that no damage is caused to the plow or its support.

Where the road passes over the Seine at the Alma Bridge, the height which is allowed above the masonry arches does not permit of establishing a conduit of the usual kind, and a special form of shallow conduit had to be used here. This is shown in section in Fig. 3. The conduit is built of cast iron in short sections, and the supporting piece is now cast into it. The sections are placed end to end and held together by steel plates bolted on above which serve also to support the groove rails of a Z-section. The latter are held in place by cast-steel brace-pieces. The other section shows the method of mounting the insulators. As the use of the shallow conduit caused an elevation of the contact-bars, amounting to five inches above the normal, it was necessary to use a special arrangement for raising and lowering the contact plow as the car passed over this point, independently of the manœuvre which is required where the contact line joins the trolley; in the latter case, the plow is to be lifted completely out of the conduit.

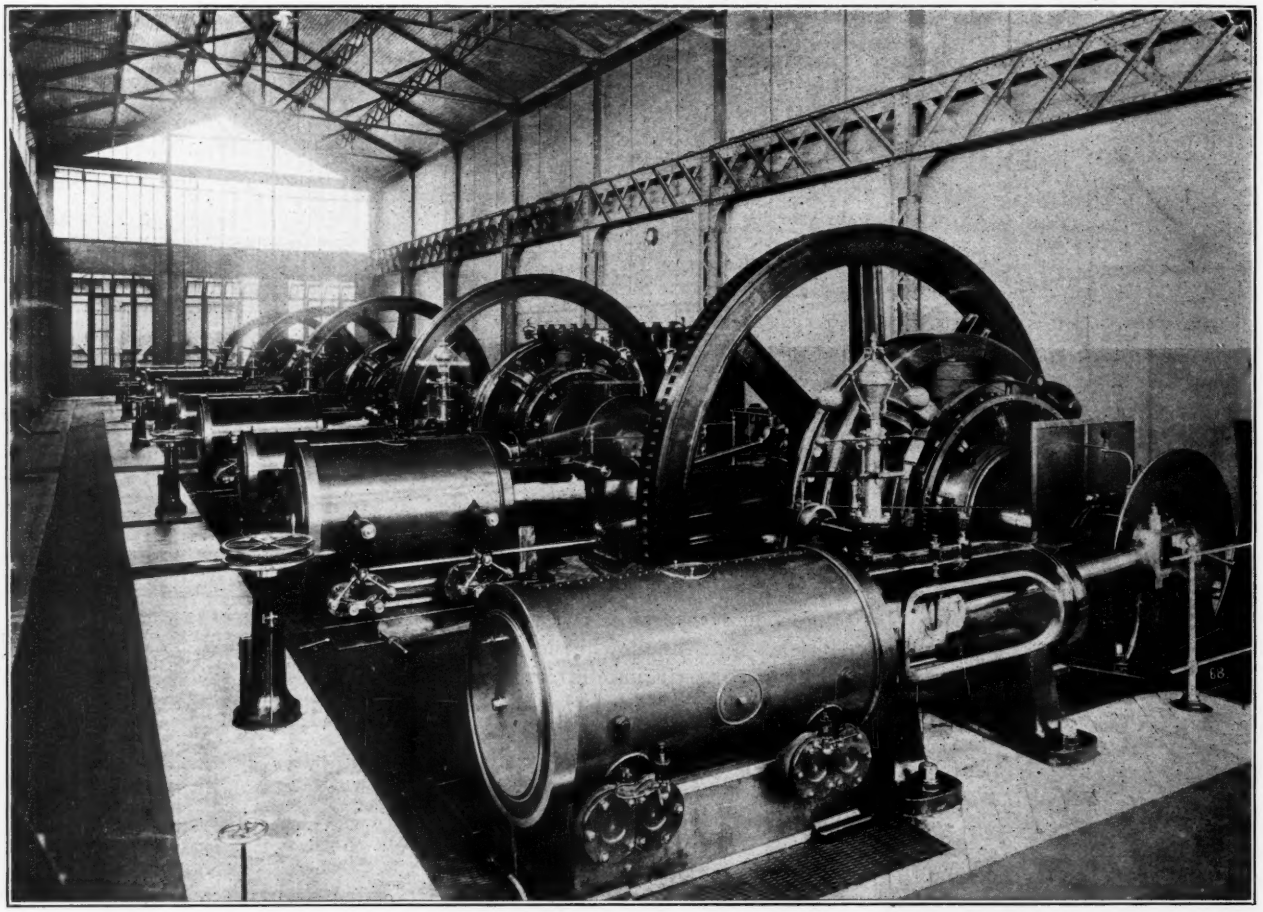


Fig. 5.—Central Station, Paris Conduit System of Electric Roads.

The problem of raising the plow has been already studied and very well solved in Europe. Thus at Berlin, at Brussels, and more recently at Budapest, it was found that the simplest and most practical method was to keep the plow always under the car, and to use a device for raising and lowering it as required. The contact plows used in these cities are designed so as to pass through the normal slot and can be raised and lowered at any point of the line, but the width of the slot thus becomes considerable, and the plow has a form which is not of the best. In the present system the form of plow has two rubbing shoes of cast iron, which are pressed by light springs and supported by horizontal hinge pieces which limit their movement. Owing to these pieces the plow is of solid build, but of course does not pass through the groove itself. It has been found in practice that this

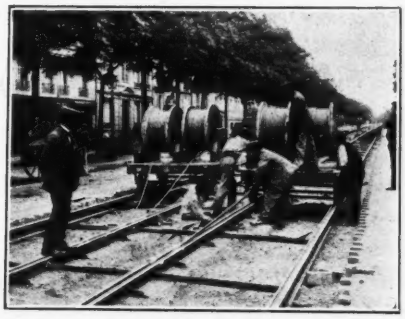


FIG. 6.—LAYING THE CABLE IN THE SLOTS.

manœuvre is not essential, as it suffices to carry out the raising and lowering of weight to facilitate the manœuvre. At the points where the conducting rails are interrupted are fixed vertical sheet-iron pieces which serve as guides for lowering the contact plow. The traps can be worked by the motorman who raises and lowers the plow at the same time by the following disposition.

One of the most difficult problems has been to establish a support for the plow which should fulfill all the requirements. The plow must be shifted freely from one side of the car to the other; when in the central position it is to be raised out of the conduit or lowered. In the lateral position it must be raised or lowered sufficiently to pass from the normal to the shallow conduit like that of the Alma Bridge. Again at the changing points of

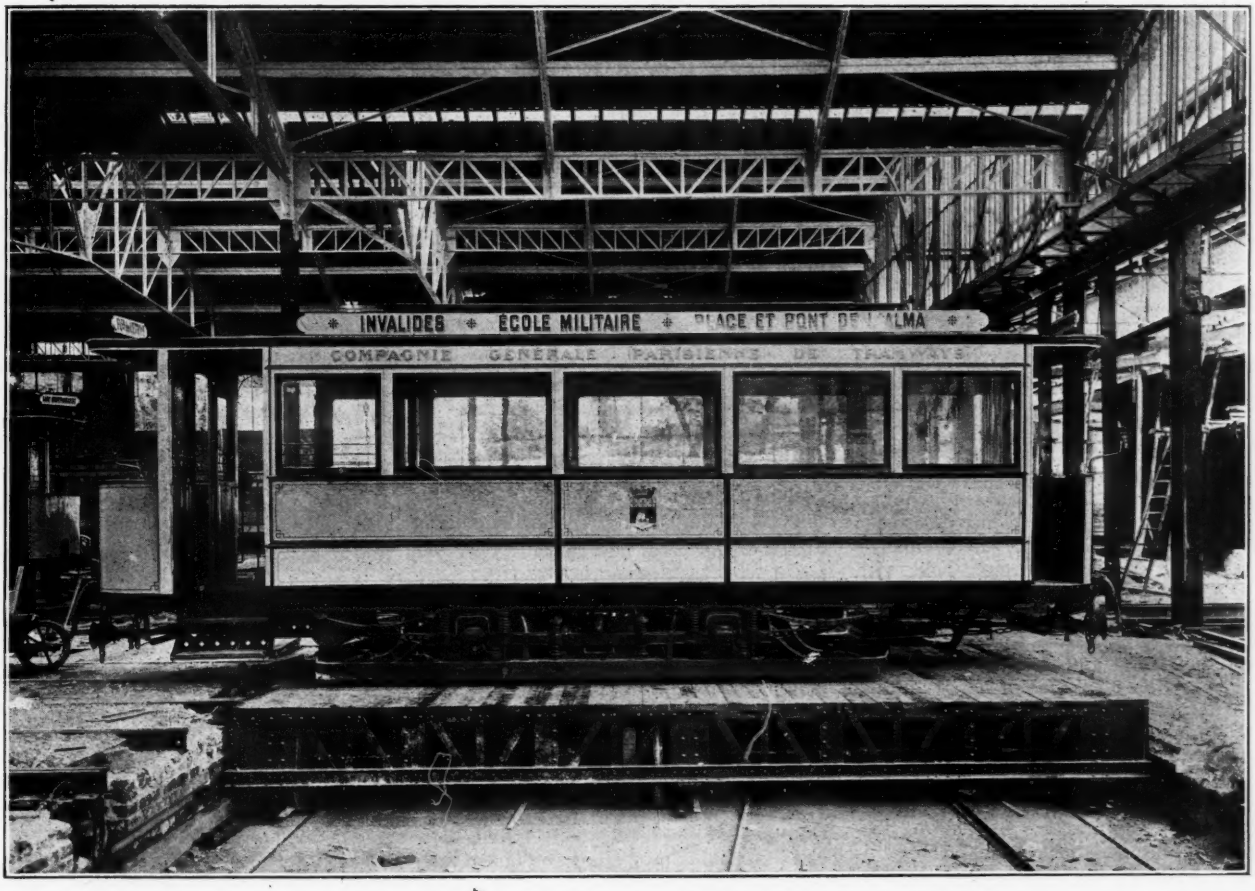


FIG. 7.—TYPE OF CAR, MOUNTED ON TRANSFER TABLE, USED ON PARIS CONDUIT SYSTEM OF ELECTRIC ROADS.

spring need not have a great mechanical resistance, for the former serve to hold the shoe in place and transmit the efforts or shocks. The springs serve simply to press the shoes lightly against the bars. The lower part of the plow has a central plate of fibre with a hard-wood piece on each side to support the shoe. The upper part of the plow is formed of two steel plates bolted together, between which passes an insulated copper conductor. The plow at the points where the conduit joins on to the trolley. A trap is used here which can be opened and closed rapidly by a simple device which has proved quite satisfactory. Along the slot are placed two trap doors of cast iron supported at the outer end by a cast-iron frame noticed above; they are hinged at the inner end to the groove rails. The traps can be raised by the simple movement of a lever provided with a counter- the plow the circuits must be established automatically by the movement of the plow itself. In Fig. 4 is shown the position of the plow in the three different forms of conduit—central, lateral and shallow; the plow is displaced laterally and can be raised or lowered through the trap. The plow is raised when in its central position by a screw which is fixed to the side beams of the truck. The screw is worked by a hand-lever like that of a controller, and at the same time the connections are changed by means of a com-

mutator which is connected to the screw by a lever. This commutator is built somewhat like a controller with cylinder and rubbing contacts. The plow is suspended by its two side-arms upon a form of rail which allows it to slide from one side to the other. In the centre, the rails are interrupted to give place to a movable carriage upon which the plow comes when in the middle position. The carriage slides up and down in a vertical support and can thus be raised along with the plow by the screw on the left by means of chains passing over a set of pulleys. The chains were attached to the carriage by a catch lever at each side which serves to hold the carriage in place. By drawing on the chain the lever is first unhooked, then the carriage rises in its sliding frame. A similar carriage is placed at each end so as to raise the plow when passing the shallow conduit. This device has been found to answer very well for the different manœuvres of the plow.

For this extensive system of roads a large central station is required. The engraving, Fig. 5, shows a general view of the dynamo room. The station is located in the western part of the city, and as it lies near the Seine it is easy to secure a coal supply. The boiler room contains seven boilers of the Niclausse type disposed in three batteries. Each of the boilers has a heating surface of 150 square yards, and can furnish from 4,000 to 5,500 pounds of steam per hour. Two steam pumps supply the boilers, along with an electric pump of the Thirion system. The main dynamo room contains five direct-coupled generating sets. The engines are of the Dujardin type, giving 300 horse-power and driving generators of 225 kilowatts. The engines make ninety revolutions per minute. The five generators furnish the current required for the seven miles of line just described; they have been built at the company's works, at Paris, and are eight-pole, with compound winding. These machines are overcompounded, so as to give 500 volts at no load and 550 at full load, with a capacity of 450 amperes.

The station contains a large marble switchboard of eleven panels, from which pass the feeders; the latter include eight insulated and armored cables of 500 square millimetres section, having a total length of 10.8 miles, four cables of the same kind having 250 millimetres section and seven smaller cables of 150 millimetres. Both the latter have a total length of 4.5 miles. The type of car used on the Etoile-Montparnasse section is shown in the engraving. It is of a handsome design and contains thirty-six places. It is divided into two compartments for first and second class. The view has been taken in the great car barn, which has been erected to accommodate the cars of the different lines, and connected with it are extensive assembling and repair shops. The car is here mounted on one of the rolling platforms, operated by motors, which serve to shift the cars from one track to the other.

C. L. DURAND.

INDUSTRIAL ELECTROCHEMISTRY AND ELECTROMETALLURGY—I.

Notes on Progress in Europe and America.

BY JOHN B. C. KERSHAW.

Aluminum in England.

The British Aluminum Company has been unfortunate since its early days, and the report presented at the seventh annual meeting of the shareholders in London, on November 21, 1902, was the worst yet received. Owing to various causes, the chief of which are stated to be the lock-up of capital in large water-power schemes in Scotland, the unsuccessful attempt to prolong the life of the Heroult patent, and the unremunerative nature of the carbide manufacture, the company is now unable to meet the payment of its debenture interest. A thorough examination of the financial position of the company has also revealed an overvaluation of stocks amounting to $100,800. This sum added to other losses, and a sum of $144,000 written off patents and good will, gives a total deficiency on the capital account of $384,000, which total for the present is carried to a suspense account. In spite of the present unfavorable position of affairs, the financial backers still believe that the company may be nursed into a more healthy position. The payment of debenture interest is to be suspended for two years, and a loan of $48,000 is to be raised to provide the necessary working capital for the intervening period. A new managing director and two new members of the board have been appointed, and it is confidently hoped that these reforms, and the recent improvement in the demand for the company's products, will in time bring about the desired results. The writer is inclined to agree with these expectations, for aluminum manufacture is successfully carried on by the same process in France and Germany. Overcapitalization and bad technical and financial control have, however, seriously handicapped the development of the industry in England, and it will take some years of solid hard work to retrieve the mistakes of the past.

Electrolytic Alkali and Bleach.

The breakdown of the arrangement which has existed for three years between the makers of bleaching powder by the old and new processes in Europe will lead to open competition in the industry, and it will be of interest to see whether, under such conditions, the new electrolytic alkali works can continue to work at a profit. Under the sales arrangement which existed between the Griesheim Firm "Elektron," of Frankfort, representing the electrolytic works, and the United Alkali Company, of Liverpool, representing the Le Blanc works, the price of bleaching powder has for the past three years been maintained at between $30 and $32.40 per ton f. o. b. at English ports. This arrangement expired on December 31, 1902, and the greater number of the large consumers of bleaching powder in England have contracted for their supplies over 1903 at a price of $16.80 per ton.

It is questionable whether some of the smaller electrolytic works will be able to make bleaching powder at a profit at this figure, and even the larger and best conducted factories will be heavily handicapped by this great fall in the selling value of their chief product.

The writer has submitted the present position of the "Electrolytic Alkali Industry" and the costs of production by the old and new processes to a careful examination, and has come to the conclusion that those works which possess a good process, and are under sound technical and commercial management, will successfully survive this ordeal of "free trade in bleaching powder" which is about to be faced. The facts and figures upon which this conclusion is based will be found in the issues of the *Electrician* (London) for November 14, 28 and December 6, 1902.

The Swiss Electrochemical Industry.

Figures have recently been published by the Electrotechnical Society, of Switzerland, which throw interesting light upon the power developments in that country. There are reported to be 235 distinct installations of electrical power, of which total 215, or ninety-one per cent, are operated by water. The maximum aggregate power available is 160,900 kilowatts, which gives an average of 680 kilowatts for each installation. The average aggregate power in use is 104,000 kilowatts, and of this total the electrochemical industries account for 24,000 kilowatts, or twenty-three per cent.

Switzerland, for its size and population, therefore occupies a very satisfactory position as regards the electrochemical and electrometallurgical industries; and no doubt, as new processes are invented and developed, the proportion of the total power applied to these purposes will increase. The electrical engineering societies of other countries might, with advantage, follow the example of the Swiss society, and collect and publish annual statistics showing the progress of power development and use in their respective countries and continents.

THE DESIGNING OF TELEPHONE APPARATUS—XIV.

BY W. A. TAYLOR.

JACKS.

On the switchboard the jacks are the connecting points of the lines entering that board; there may be one for each line or a number of them. These jacks or spring-jacks are made so as to receive

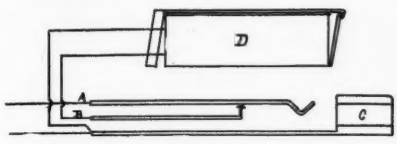


FIG. 36.

the connecting plugs of the connecting cords. In addition to the serving as points of connection the jacks are arranged to cut out certain signaling apparatus such as the connections running to the drop or to the lamp relay as in the case of a lamp signaling board. This cutting off is either direct as by opening the circuit or short-circuiting the piece of apparatus or it may be indirect as in cases where an auxiliary relay acts to cut out the signaling apparatus. As may be expected, there are a great many forms of spring-jacks arranged to perform different functions. The common form, as used on metallic circuit magneto switchboards, is shown in Fig. 36. In this jack the line connections are made on the spring, A, called the tip spring, and the body or frame, C, called the sleeve. C is the ferrule within which the plug is placed.

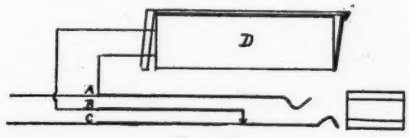


FIG. 37.

B is normally in contact with the tip spring, and is sometimes called the local spring. The spring, B, is connected with one terminal of the drop, D. The other terminal of the drop connects with the sleeve or ferrule. It is obvious that a spring may be substituted for the body of the jack and that the local spring may be made to stand normally against the spring which connects to the sleeve of the plug as in Fig. 37, in which case the drop connects to springs A and B. A still further form of jack is shown in Fig. 38, in which the drop is cut off entirely from the tip and sleeve springs. The jack is not usual except in multiple boards where there are a number of them connected in series with each other, as shown in Fig. 39. There is, however, an additional connection made to the ferrule or sleeve, F, upon which a busy test is obtained. In this arrangement the line, L, comes into the tip and sleeve connection of the first jack and passes out through the local springs to the tip and sleeve of the next jack, and so on until the drop is reached after having passed through all the jacks. A plug being inserted into any of the jacks will cut off the drop. The sleeves, FFF, are all connected in common so that if any plug should happen to be inserted in that series a click will be communicated to the ear of the operator wishing that line, as soon as the tip of her plug touches the sleeve of the jack. There is still another simple form of jack which is shown in Fig. 40. This jack has no contact points except where it touches the plug. As shown, when the plug is inserted the spring, B, and sleeve, C, are short-circuited by the sleeve of the plug which cuts out the signal. In other circuits a three-conductor plug is used which con-

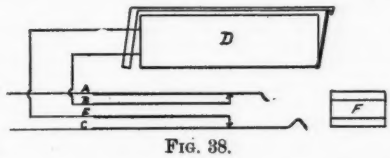


FIG. 38.

nects with each of the three conductors of the jack. This is used with central energy systems in which the battery passes from the cord through one of the conductors to operate the necessary apparatus for cutting out the signal.

There has been considerable argument as to the advisability of using the sleeve of a jack for making a connection for talking, because of its liability of cutting off. It has been the writer's experience that if the jack is made properly there will be no trouble from this. Taking Fig. 36, for example, if enough tension is put into spring, A, it will certainly make as good a sleeve connection as may be desired. In a jack like Fig. 38 should springs A and C be of such a tension that they will hold the plug loosely in the sleeve, then there might be a cutting off of whatever circuit was connected to F.

In making a spring-jack it is necessary to have all the springs of the best spring metal, preferably German silver, punched or cut from the sheet with the grain running lengthwise. Spring German silver, with eighteen per cent nickel, is generally used. The length of the spring should be long enough so that the spring may move twice as far as necessary without receiving a permanent set. A spring should be formed as nearly as possible to the desired shape in the forming press so as to require a minimum amount of adjustment at the assembling bench. If that is not the case the springs are apt to be marred or bent out of shape by the assembler, and after a spring is once scratched or bent

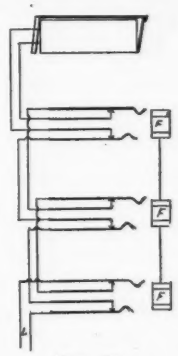


FIG. 39.

out of shape it is nearly useless. It is a useless expense at any rate to require a great deal of adjustment. There is more money lost on the assembling benches in some factories than there are dividends each year. It is much better in designing the jack to make all springs as nearly straight as possible. It is of course necessary to have a certain amount of curve in the springs to give them tension. There must also be a short curve on the ends of the tip and sleeve springs to permit the end of the plug to slip by. It is nearly always possible to prevent eccentric formation of springs.

Where it is necessary to have a spring short, the gauge of the spring should be

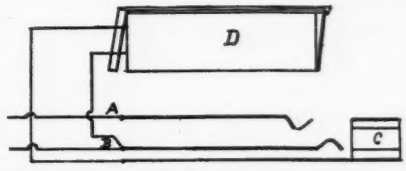
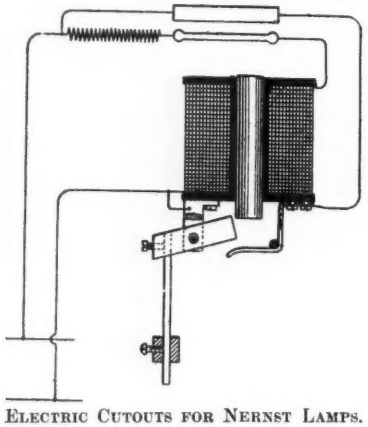


FIG. 40.

thin, for by so doing the spring permits of a greater movement without receiving a permanent set. If then it is necessary to have a greater tension the stock may be made wider. With the same material and length of spring with the least thickness permits of greater movement. The amount of tension necessary is sufficient if the plugs are held tight enough so that they do not become readily disconnected during the ordinary operation of the switchboard. If the contacts are all right such tension will do nicely. Excessive tension should be avoided, as the plugs and sleeves of the jack wear too rapidly. Where the proper contact points are used a heavy pressure is not needed or desired.

Electrical Patents.

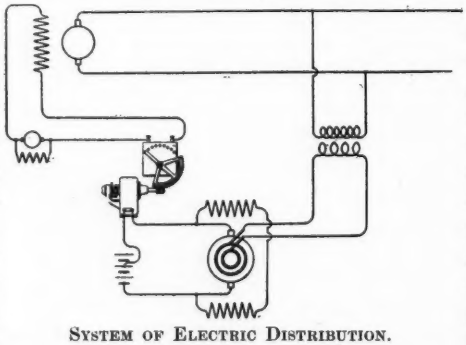
Mr. George Westinghouse, of Pittsburg, Pa., has purchased a patent which relates to electric cutouts and is particularly valuable for use in connection with Nernst lamps. This is the invention of Mr. Henry N. Potter. In operating cutouts for this class of lamps designed to operate on all frequencies—such, for example, as 3,000 alternations per minute—difficulty has been found in preventing a noise being produced by the vibration of parts. Owing to the need of securing great freedom of movement in such cutouts, the bearing or bearings of the moving part must be very loose. In the case of an immovable pin surrounding by a collar attached to the moving part the opening in the collar is generally made considerably larger than the diameter of the pin. Unless means be provided for



Electric Cutouts for Nernst Lamps.

preventing it a short diametral motion of the collar relative to the pin during the periods of weak magnetic attraction if the downward pull of gravity exceeds ninety degrees as the intermittent effects of the magnetic force and of gravitation will cause the collar of the moving part to bump up against the pin on one side and then fall away from it and bump against the other side, thereby making a noise. To prevent this, the magnetic force of the gravitation restraining force should have their pulls exerted at an angle with each other of less than ninety degrees—that is to say, as gravity pulls the moving part downward the movement due to the magnet should be slantingly downward. By organizing a cutout apparatus so as to produce this relation of forces the noise of the cutout can be prevented. The invention which is thus indicated was first suggested to Mr. Potter by a recognition of the fact that these moving parts either have a period, which causes them to be resonant at the frequency employed, or else their natural period is so short in comparison to the duration of one alternation that they are able to execute considerable movement between alternations. It therefore seemed to be possible to correct this tendency by giving to the moving part or parts of a cutout apparatus a natural period which should be long in comparison to the duration of one alternation. This lengthening of the period of the moving armature can be easily accomplished on the general principle of the metronome—in other words, of an oscillating body having its centre of gravity, but slightly below the centre of support and having a considerable portion of its weight relatively far above the centre of support. Even short pendulums so constructed may be made to have very long periods. In the cutout the slight stable equilibrium of the metronome is not necessarily incorporated; but the combination may be put in unstable relation by placing the centre of gravity above the centre of rotation and support. The period of the moving part can readily be made variable by means of an adjustable weight which can be set at varying distances from the centre of oscillation. In this way the natural period of the cutout can be made incommensurable with any particular frequency on which the lamp may have to operate.

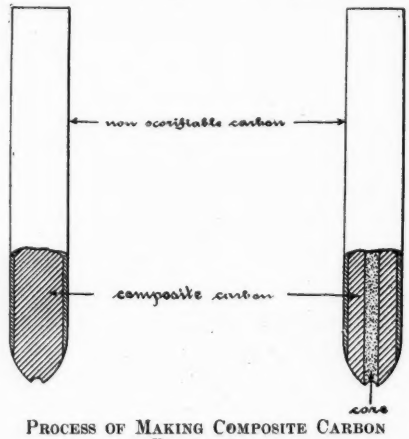
A patent has been granted to the General Electric Company on a system of electric distribution, invented by Mr. Harold W. Buck, of Schenectady, N. Y. In its general nature the invention consists of automatically actuated means for varying the field strength of a dynamo-electric machine. The field-controlling means is responsive to changes in direction of current flowing in a circuit in



System of Electric Distribution.

which two electromotive forces are maintained, one of which is substantially constant, while the other varies in response to variation of electromotive force on the mains connected to the dynamoelectric machine. The electromotive forces in this circuit are arranged to balance each other when the electromotive force of the mains is normal, but to cause current to flow in one direction when the electromotive force of the mains drops and to cause a reversal of current when the electromotive force of the mains rises.

A Frenchman, Mons. Andre Blondel, residing in Paris, has patented in this country a composite carbon electrode for arc lamps, which he thus describes: "My invention relates to an improvement in the manufacture of carbon electrodes for arc lamps, in which to the carbon base are added coloring and light-producing salts—such, for instance, as salts of calcium, magnesium, barium, sodium, potassium, thorium, caesium and the like—in order that the luminous efficiency of the arc may be enhanced. These composite carbons are well known in the art and have been tried by several scientists. The chief obstacle to the general employment of

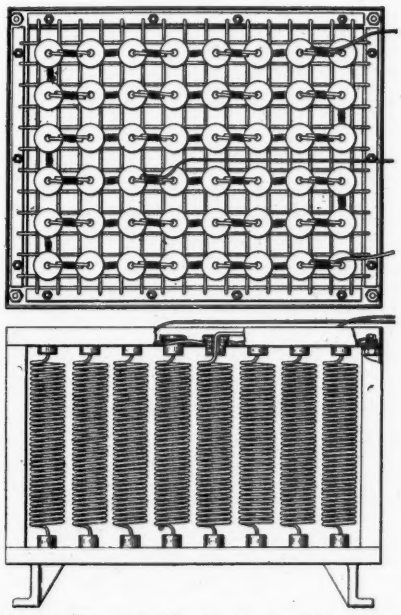


Process of Making Composite Carbon Electrodes.

such carbons has been the fact that in the heating of the prepared carbon its salts in melting produce abundant scoriæ, which either drop from the carbon or obstruct the arc. This obstacle is especially noticeable in lamps wherein the positive composite carbon is the upper electrode of the lamp. In an application for patent filed by me on March 26, 1902, under the serial No. 100,024, one means for overcoming this obstacle is set forth, in which the positive composite carbon is used in the lamp as the lower electrode. In my present invention a means is devised for making the electrode whereby all or nearly all of the scoriæ are got rid of, and to this end the invention consists in forming the main part or body of the electrode of carbon combined with the salts of calcium, magnesium and similar light-producing salts and in coating or enclosing said body with a substantially thin layer of non-scorifiable carbon. This layer consists either of pure carbon or carbon combined with a small percentage of the light-producing salts and serves to

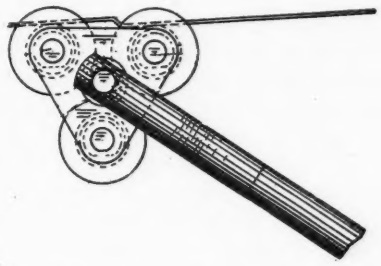
protect the main part or body of the electrode from being superficially burned or licked by the flames before the production of the arc required."

The General Electric Company controls a patent recently issued to Mr. Frederick Mackintosh, of Schenectady, N. Y., on a novel form of rheostat for electric circuits, the object of the invention being to permit freer ventilation than is commonly provided in devices of this character and thereby prevent excessive heating under large currents, at the same time simplifying and cheapening the construction. To this end, the resistance conductor is composed of wire with all parts of its length freely exposed to the atmosphere and out of contact with the framework. The sectional units of the device are mounted on insulating supports suspended in an open-work frame, through which the air may circulate. The insulators are formed of porcelain in the shape of hollow plugs, each having a flange which rests upon a perforated end frame, the bodies of the insulators projecting through the perforations. The framework, as a whole, may be of any desired character, the top and bottom frames which carry the insulators being preferably formed of a network of cross iron wires to all parts of which the air may freely circulate.



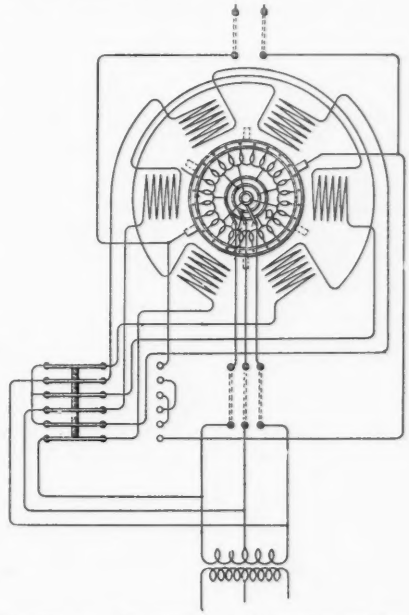
NOVEL FORM OF RHEOSTAT FOR ELECTRIC CIRCUITS.

A new trolley pole that is claimed to have distinct advantages over those now in general use has been patented by Mr. Theodore C. Buder, of St. Louis, Mo. On the upper end of the pole is journaled a pair of spaced triangular plates that are freely revoluble. Journaled to and between these plates are three trolley wheels so arranged that two will, under normal conditions, bear against the wire, one being disposed directly behind the other. As a result of this arrangement, the danger of the trolley jumping the wire is to a great extent obviated, and a continuous contact is assured. This will be apparent when it is considered in connection with small obstructions, such as kinks in the wire or the like. These obstacles, as is well known, will cause a single wheel to bound out of contact for an instant even if it does not entirely become disengaged. With the improved structure, however, a continuous contact is secured, for should the first wheel become dislodged, the rearmost, which has not yet met the obstruction, will remain in contact, and by the time the latter wheel reaches it the foremost is back in position. In case a larger obstruction is met with, the head as a whole simply revolves over it, thus bringing the inoperative wheel into position as the foremost one.



NEW FORM OF TROLLEY POLE.

Thomas J. Johnston, of New York city, has protected by means of two patents improvements in the means for starting alternating-current motors. Under ordinary conditions, the starting of the synchronous motor is attended with a rush of current in the armature for which reason starting devices operating by electrical methods have been proposed and to some extent adopted. For these devices, Mr. Johnston substitutes a change in connections of the synchronous machine, which may be readily effected by ordinary switches of common construction. The method of operation involved is, briefly, feeding the fields of the machine with the alternating current, first opening the connection from the main line to the armature circuit at the collecting rings or by a suitable switch. The armature is placed on short-circuit and starts with considerable torque, like an ordinary induction motor, and gradually runs up to nearly synchronous speed. After approximating synchronism, if the motor be polyphase it may be changed from an induction machine to synchronous and the rotary field torque would bring it up to synchronism. This, however, is not the best method of exercising the invention on account of the fluctuations of electromotive force which tend to disturb the system and which in a lighting system are prohibitive of such a method of operation. The device is therefore so arranged that while the alternating current is flowing in the field-circuit the number of poles is permuted to be less than that used when the continuous-current field is employed. By this method of operation the armature is driven considerably above the speed, due to the normal frequency in the circuit. It is, of course, manifest that this permutation may be anything desired—that is, the combination may be such that the armature will be revolved at very high speed if allowed, by which I mean that speed which will correspond to the number of pairs of poles into the alternations. For instance, in a six-pole machine the switches are arranged so that the alternating current generates a bipolar field. Thus the armature is rapidly and powerfully accelerated to a speed in excess of normal synchronism. Afterward the switches may be thrown, shifting the alternating current to the armature and coupling the field upon the source of continuous current. Commonly the motor is self-excited and its field is shunt-wound. Thus when energy at the normal frequency is supplied to the armature circuits the machine gradually slows down until it falls into step, and this without any excessive fluctuation.



SYSTEM FOR STARTING OF ALTERNATING-CURRENT MOTORS.

RAILROAD CAR BRAKING—III.

BY R. A. PARKE.

In accomplishing the purpose of applying an increased brake-shoe pressure during the early part of the stop, the quick-action automatic brake has been modified by the addition of an automatic pressure-reducing valve to each brake cylinder, by the use of which a high air pressure is utilized in the brake cylinder in emergency applications of the brakes, and is gradually reduced to the level of that which, in earlier forms of the air-brake, is maintained continuously throughout the stop without sliding wheels at the close. That material progress in braking is marked by this step will be easily appreciated when it is understood that, with the use of this apparatus, called the "high-speed" brake, stops from the higher speeds are about thirty per cent shorter than those attained by the quick-action brake. By the more prompt application of a greater brake-shoe pressure than immunity from injurious wheel sliding permitted in ordinary applications of the brakes, the "emergency stop" became clearly distinguished by the quick-action air-brake, and in passenger train service it was shortened to about eighty per cent of the shortest stop of the older automatic air-brake. By the application of a greater brake-shoe pressure during the early period of stops for utilizing a larger proportion of the retarding force realized at lower speeds the high-speed brake shortens emergency stops from high speeds to about seventy per cent of those of the quick-action brake, or fifty-six per cent of those of the old automatic brake. The increased brake-shoe pressure is secured by the use of a high air pressure, which, through the operation of the automatic reducing valve, is available only in emergency applications of the brakes, the moderate pressures of the old automatic brake being still preserved in ordinary operation to prevent possible injury of wheels. But the higher storage pressure of the auxiliary reservoir air is equivalent to a correspondingly increased volume of air stored at the pressure of ordinary service, and thus the high-speed brake also provides for repeated brake applications without recharging the auxiliary reservoirs—an incidental advantage greatly increasing the security of trains under conditions of daily occurrence.

It is opportune to digress at this point to consider an application of the high-speed brake which concerns conditions to which electric railroad operation is peculiarly adapted. Hitherto, the ordinary stops of railroad trains have generally consisted of a preliminary reduction of speed at a long distance from the stopping point, to bring the train under full control, and then of a gradual reduction of the remaining speed, continuously or in stages, to suit the conditions or the operator's views, until the train comes to a standstill at the stopping point. The stops of express trains have been infrequent, and the speed of way trains has been moderate, so that, in both cases, the time occupied in the stop has not called for careful consideration. But with the rapid growth of suburban traffic in all large cities, particularly since the introduction of electric railroads, the changed operating conditions of suburban trains give great importance to the time consumed in the frequent stops. Both in steam and electric railroad traffic of this kind, large expenditures of thought and money have been made to secure high acceleration in starting trains, while almost nothing has been done to secure the equally important high retardation in stopping. Every start is accompanied by a stop, and if economy of time is important in one, it is equally important in the other. The neglect which efficiency of stopping has suffered is doubtless due to the fact that, while acceleration in starting has generally been limited to that which may be acquired from the rail friction of a few wheels, the retardation resulting from brakes upon practically all the wheels is so effective in comparison that its inferiority to what it might be is overlooked. Moreover, the character of the train stop of ordinary service has been so firmly established and avoidance of the use of the full power—the emergency application—of the brake has been insisted upon for such good reasons, that departure from the customary "service" application of the brakes does not readily suggest itself. But the conditions now under consideration are quite different. At low speeds the violence of the emergency application is apt to result in discomfort to passengers, and the brake-shoe pressure is too near the wheel-sliding limit to be desirable. But at the high speeds attained between stations in efficient suburban service the initial coefficient of brake-shoe friction is so low that no perceptible shock or disagreeable effect accompanies an emergency application of even the high-speed brake, and the coefficient of friction near the end of the stop is so much lower, through the effect of continued rubbing through so much longer distance than in a stop from the lower speeds, that the danger of wheel sliding is not troublesome.

There is also another important time-saving feature of the emergency application for service stops in train service of this character. In making an ordinary service application, the personal equation of the operator is an important element. The proper point at which to apply the brake, the force of initial application and each subsequent increase or reduction of the braking force (to prevent overrunning or stopping short of the station) are matters of personal judgment in which men differ materially, the consequence of which is that, to be safe, the brakes are usually applied too early and time is lost in drifting into the station at low speed. In an emergency application the personal element is largely eliminated, as the full application is practically instantaneous, and, where definite speed may always be depended upon, the point at which the brakes should be applied may be designated by a signal post. Thus, full speed might be obtained over much the larger part of the distance traversed during an ordinary service stop, followed by a quick stop of the high-speed brake, and fully half the time occupied by the service stop would be saved.

Thus far, consideration of means for approaching the theoretically possible retarding force has been confined to those for overcoming the obstacles due to the complicated variation of the coefficient of brake-shoe friction. This is a subject which, while of manifest interest and importance to those who operate railroads, chiefly concerns those who supply the motor mechanism for applying the pressure of the brake shoes upon the wheels. The distribution of pressure upon the rails, through the wheels, which defines the maximum rail friction itself, and the construction of running gear and brake-beam supports to permit the utilization of the rail friction for retardation, constitute a branch of the subject which ought seriously to concern those who construct the running gear and apply the motive power, but which is almost invariably subordinated to every other consideration and is usually overlooked entirely. It is a strange fact that, although the brake occupies the uppermost position of importance among railroad safety appliances, the actual work of stopping trains when disaster impends, depending entirely upon it—and almost as much depending upon it as upon the motive power apparatus for high efficiency in local and suburban train operation—every effort is apparently concentrated upon attaining

the maximum acceleration in starting trains and the almost equally important matter of high retardation in stopping is so far neglected that the use of efficient foundation brake gear is not only usually unprovided for but often prohibited, and especially where electricity is the motive power. It is obvious that the force with which the brake shoes should be applied to a pair of wheels depends primarily upon the pressure of those wheels upon the rails. In car construction the weight is usually, but not always, equally distributed upon the various wheels. In electric car construction it frequently occurs that the motors are so applied that greater weight is supported by one pair of wheels than by another. In any case where the wheel pressure materially differs, proper regard for brake efficiency demands that the brake-shoe pressure shall correspondingly differ. But, entirely independent of the normal distribution of weight upon the various wheels of a vehicle, retardation itself, caused by the application of brakes to the wheels, involves a redistribution of the weight which, where the retardation corresponds to the maximum brake application, inevitably results in a very serious loss of braking efficiency unless means be provided for varying the brake-shoe pressure to correspond with the changed wheel pressures. Whatever the source of the retarding force, its operative effect in retarding the motion of the car is the same as that of an infinite number of small retarding forces, each engaged in retarding the motion of an elementary portion of the mass of the car, and, therefore, in order that a single retarding force, or a combination of retarding forces shall so operate without either changing the direction of the cars' motion, or producing rotation of the structure as a whole, or calling into operation other forces to prevent such deviation or rotation, the forces or the resultant of the combination of forces must be so applied that it shall pass through the centre of inertia of the mass in a direction opposite to that of the motion of the car. In utilizing the rail friction for the retarding force, while it has the proper direction, it is applied at the lowest points of the mass of the car and must therefore either cause rotation of the entire structure or the interposition of other forces which combine with the retarding force to preserve the simple motion of translation. The car may be considered as a single mass or as being composed of three separate masses, according as it is provided with one rigid or two swiveling trucks. Rotation of the car by the eccentric retarding force does not occur in either case; in the first, it is because the reacting pressure of the rails upon the forward pair of wheels exceeds that upon the rear pair of wheels in such measure that the contrary rotative moment, thereby introduced, just balances that of the eccentric retarding force also applied by the rails to the wheels. In the case of the car with two trucks the retarding force is applied at the lower extremity of the two trucks, being equally divided between them (if constructed alike); that portion of the retarding force necessary to retard the mass of the trucks is absorbed in so doing, and the remainder is applied by the trucks to the car body at substantially its lowest extremity. In consequence, the centre of inertia of the car body being above the points of application of the retarding force, rotation through the eccentrically applied retarding force is prevented only by the resisting rotative moment of a greater supporting pressure from the forward than from the rear truck. Each truck is subject to the combined rotative moment of the eccentric retarding force at its lower extremity, and the eccentric reacting force from the car body at its upper extremity, and rotation is prevented only by a contrary rotative moment of a greater supporting pressure by the rails upon the forward than upon the rear pair of wheels. Thus the very act of applying the brakes to the wheels produces a new and very different system of wheel pressures upon the rails, and it is the wheel pressures under those conditions which determine the available retarding force. As the total pressure of all the wheels upon the rails can not vary, it is obvious that the existence of a greater rail pressure for the forward than for the rear pair of wheels of the truck implies the virtual transfer of a portion of the normal pressure from one pair of wheels to the other. The brake-shoe pressure upon the rear pair of wheels must be insufficient to cause the wheels to slide upon the rails, and must therefore be cut down in proportion to the transfer of weight from the rear to the forward pair of wheels. But as the forward pair of wheels will become the rear pair when the car moves in the opposite direction, the brake-shoe pressure upon that pair of wheels must also be limited in the same way. Thus the braking pressure upon each pair of wheels must be restricted to correspond with the minimum pressure of the wheels upon the rails, and when it is understood that this minimum rail pressure, which occurs in the maximum application of the brakes, is less than eighty-five per cent of the normal, or, in other words, the effective wheel pressure, available for braking, of an ordinary eight-wheeled passenger car is but eighty-five per cent of the weight of the entire car, the importance of an investigation and of the provision of means to compensate for such a serious loss of retarding efficiency becomes clearly manifest and a solution of the problem, devised by the writer, is submitted.

FIG. 1.

The first step in determining the rail pressure is to find the reaction between the car body and the trucks, after which investigation is confined to truck conditions alone. The only means of the application of force to the car body are the trucks and the draw-bars. In any case where, in a train of vehicles, the ratio of the retarding force of the brakes to the weight is greater for some vehicles than for others, the forces transmitted through the draw-bars require consideration; but in electric service, where cars are either operated singly or in trains that permit equally effective brake retardation upon the several vehicles, no one produces a retarding effect upon another, so that draw-bar forces are eliminated and the problem is more simple than in the case of steam railroad trains, where draw-bar forces accompany brake application, because all vehicles are not uniformly braked. It is true that, in a train of electrically operated cars, defective apparatus upon one or more of the cars might result in the application of the brakes upon only a portion of the cars, whereby retarding forces would be transmitted through the draw-bars to the unbraked cars, but consideration can hardly be extended to such uncertain accidental conditions.

Fig. 1 represents the body of a car from which the trucks have been removed and replaced by arrows representing the supporting and retarding forces which they apply to the car. The trucks being alike and subject to the same retarding rail friction, each truck contributes the same horizontal force (H) to retard the mass of the car body, and the forward truck applies a vertical supporting pressure (P_1), while the rear truck similarly applies the supporting pressure (P_2). The weight (W_1) of the car body is represented by an arrow acting downward through the centre of inertia of the car,

midway between the truck supports and at distance (k) above them. The distance between the truck supports is represented by 1. These are all the real forces acting upon the car body (in the absence of draw-bar forces), as the resistance of the atmosphere is so insignificant in comparison with the rail friction that it may be neglected.

The rail friction causes all parts of the car structure to be retarded at a certain rate (p) and the horizontal forces (H) from the trucks are absorbed in overcoming the resistances of inertia of all the various elements of mass of the car body, which latter thus constitute a system of imaginary forces that may be represented in the aggregate by an equivalent horizontal force, which is the product of the mass of the car body (W/g, where g represents the acceleration of gravity) and the common retardation (p), acting at the centre of gravity in a direction opposite to that of the retarding forces H. The operation of the real forces must thus be equal and opposite to that of the imaginary forces, and the following conditions are therefore evident:

$$P_1 + P_2 - W_1 = 0, \text{ or } P_1 = W_1 - P_2$$

$$2H = \frac{W_1 p}{g}, \text{ or } H = \frac{W_1 p}{2g}$$

$$W_1 \frac{l}{2} - P_2 l = \frac{W_1 p}{g} k, \text{ or}$$

$$P_2 = \frac{W_1}{2} - \frac{W_1 p}{g} \frac{k}{l}$$

Also combining the first and last of these equations,

$$P_1 = \frac{W_1}{2} + \frac{W_1 p}{g} \frac{k}{l}$$

By comparison of these values of P_1 and P_2, it is evident that of the weight $W_1/2$, normally supported by each truck, the weight $(p\ k)/(g\ 1)\ W_1$ has, through the application of the brakes, been removed from the rear truck and transferred to the forward truck. The centre of gravity of car bodies, especially in electric car construction, where apparatus of considerable weight is carried below the floor, is generally low, so that the fraction $k/2$ is usually not great, and in some cases its consideration may be neglected in what follows. It is clear, however, that, inasmuch as the rail pressure upon the rear truck is that which limits the brake-shoe pressure upon either, we are concerned only with the conditions relating to the rear truck, and any conclusions reached regarding the applications of brakes to that truck are also applicable to the forward truck.

Fig. 2 represents the rear truck, to which is applied the vertical, car-body pressure P_2, midway between the wheels, and the horizontal reaction, H, from the car body, opposing the retarding force applied by the truck to the car body, at a height, h, above the rails. The rails have been removed and in their place the rail pressures R_1 and R_2 and the corresponding rail friction T_1 and T_2, are indicated by arrows, as applied, respectively, to the forward and rear pairs of wheels. It may be noted, in passing, that, although each wheel has a separate rail pressure and rail friction, the pair of wheels mounted upon the same axle are rigidly secured together, so that if one turns or slides the other must accompany it, and the simple method of treating the pair as a single element, operating under the sum of their rail pressures and brake-shoe frictions, is subject to no objection of any kind. The weight (W_2) of the truck is represented by an arrow, acting vertically downward through the centre of inertia, at a point

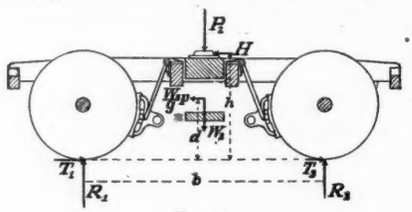


Fig. 2.

midway between the wheels and at a height, d, above the top of the rails. These constitute all the real forces acting upon the truck from without. (Although other forces, due to the brake shoes and apparatus, act coordinately, they are altogether internal forces and therefore have no influence upon the relation of the truck to masses.)

Each elementary portion of the mass of the truck is retarded and, through the resistance of its inertia, absorbs a portion of the retarding force, such resistances constituting a system of imaginary forces equivalent to the horizontal force $(W_2 p)/g$, acting at the centre of gravity, in a direction opposite to that of the retarding forces T_1 and T_2. From the equality of the real and imaginary forces, the following relations are evident:

$$R_1 + R_2 - W_2 - P_2 = 0 \text{ or } R_1 = W_2 + P_2 - R_2$$

$$T_1 + T_2 - H = \frac{W_2 p}{g} \text{ or } T_1 + T_2 = H + \frac{W_2 p}{g}$$

$$W_2 \frac{b}{2} + P_2 \frac{b}{2} - R_2 b - H h = \frac{W_2 p}{g} d, \text{ or}$$

$$R_2 = \frac{W_2}{2} + \frac{P_2}{2} - H \frac{h}{b} - \frac{W_2 p}{g} \frac{d}{b}$$

Also, combining the first and last of these equations:

$$R_1 = \frac{W_2}{2} + \frac{P_2}{2} + H \frac{h}{b} + \frac{W_2 p}{g} \frac{d}{b}$$

Giving H and P_2 the values already found, the last three of these equations become, respectively,

$$T_1 + T_2 = \frac{W_1 + 2\ W_2}{2} \frac{p}{g}$$

$$R_2 = \frac{W_1 + 2\ W_2}{4} - \frac{W_1}{2} \frac{p}{g} \left(\frac{h}{b} + \frac{k}{l}\right) - \frac{W_2 p}{g} \frac{d}{b}$$

$$R_1 = \frac{W_1 + 2\ W_2}{4} + \frac{W_1}{2} \frac{p}{g} \left(\frac{h}{b} - \frac{k}{l}\right) + \frac{W_2 p}{g} \frac{d}{b}$$

Here again, comparison of these values of R_1 and R_2 shows that, besides reducing the rail pressure upon each pair of wheels of the rear truck, to the extent of $(1\ p\ k)/(2\ g\ 1)\ W_1$, the effect of applying the brakes has also been to transfer from the rear to the forward pair of wheels the weight

$$\frac{1}{2} \frac{p}{g} \frac{k}{l} W_1 + \frac{p}{g} \frac{d}{b} W_2;$$

and, as the front pair becomes the rear pair of wheels upon reversing the direction of motion of the car, the available wheel pressure for braking purposes has been reduced from

$$\frac{W_1 + 2\ W_2}{4}$$

for each pair of wheels, to

$$\frac{W_1 + 2\ W_2}{4} - \left\{ \frac{W_1}{2} \frac{p}{g} \left(\frac{h}{b} + \frac{k}{l}\right) + W_2 \frac{p}{g} \frac{d}{b} \right\}$$

From the first of the last three equations,

$$p = 2 \frac{T_1 + T_2}{W_1 + 2\ W_2} g$$

For simplicity and greater convenience, $W_1 + 2\ W_2$, the weight of the entire car, may be designated by W and thus

$$p = 2 \frac{T_1 + T_2}{W} g$$

Applying this value of p in the expressions of R_1 and R_2,

$$R_2 = \frac{W}{4} - \left\{ W_1 \left(\frac{h}{b} + \frac{k}{l}\right) + 2\ W_2 \frac{d}{b} \right\} \frac{T_1 + T_2}{W}$$

$$R_1 = \frac{W}{4} + \left\{ W_1 \left(\frac{h}{b} - \frac{k}{l}\right) + 2\ W_2 \frac{d}{b} \right\} \frac{T_1 + T_2}{W}$$

It is to be observed that these expressions for the rail pressures of the rear and forward part of wheels of the rear truck are true for any rail frictions, T_1 and T_2, that may be available. If f_1 denotes the coefficient of static rail friction, the maximum values of T_1 and T_2 are f_1, R_1 and f_1, R_2, respectively. If then for R_1 and R_2, their corresponding values T_1/f_1 and T_2/f_1, respectively, be substituted, the above equations may be solved for T_1 and T_2, and their values found for the condition of maximum efficiency. They are

$$T_1 = \frac{f_1 W}{4} \frac{W b + 2 f_1 (W_1 h + 2 W_2 d)}{(W + 2 f_1 W_1 \frac{k}{l}) b} \quad (1)$$

$$T_2 = \frac{f_1 W}{4} \frac{W b - 2 f_1 (W_1 h + 2 W_2 d)}{(W + 2 f_1 W_1 \frac{k}{l}) b} \quad (2)$$

In order to understand now what results in practice from this transfer of weight, where it is customary to apply to each wheel the greatest brake-shoe pressure that will slide none of them, let $T_1 = T_2 = f_1 R_2$ be substituted in the value of R_2; then, upon solving the equation

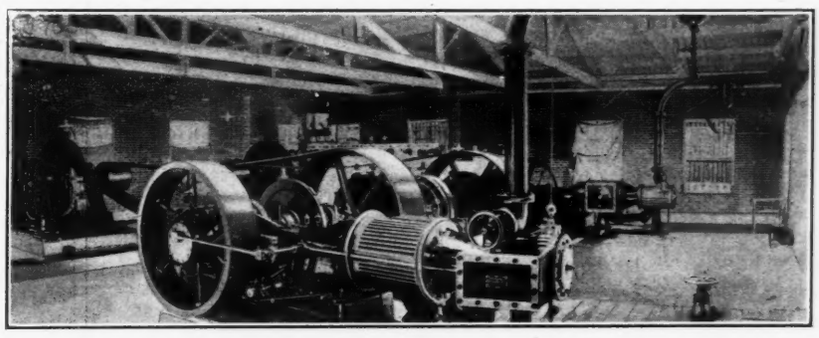
$$T_1 = T_2 = \frac{f_1 W}{4} \frac{W b}{W b + 2 f_1 [W_1 (h + k \frac{b}{l}) + 2 W_2 d]}$$

The average conditions of the passenger cars of steam railroad service are fairly represented by the values $b = 84''$, $h = 34''$, $k = 32''$, $l = 480''$, $d = 21''$, $W_1 = \frac{2}{3}$ W and $W_2 = 1/6$ W. Assuming that, in safe average practice $f_1 = 0.25$, it is thus found that, instead of a maximum rail friction of f_1 W/4, for each pair of wheels, as ordinarily supposed, the maximum is but $0.834 f_1$ W/4.

This serious loss of available retarding force induced the writer some time since to investigate the conditions for the purpose of finding, if possible, a means of automatically proportioning the brake-shoe pressure upon the forward and rear wheels of the truck, so that they should more nearly correspond to the rail frictions of equations (1) and (2). Using the above values of b, h, k, l, d, W_1 and W_2, in those equations, $T_1 = 1.151 f_1/4$ W and $T_2 = 0.806 f_1$ W/4 so that $T_1 + T_2 = 0.978 f_1$ W/2 might be realized, while only $0.834 f_1$ W/2 is ordinarily attained in practice. Any means of making the possible rail friction of the forward pair of wheels fully available would thus increase the braking efficiency more than seventeen per cent.

American Electrical Machinery in Asia.

The American Government has received from Minister Allen, of Seoul, extracts from a report published in a Japanese newspaper, in which very favorable mention is made of the plant of the Seoul Electric Company. The plant in question is said to be the largest single electrical plant in Asia. It was built for the Korean Company by an American firm—Collbran & Bostwick—which holds the property under mortgage. The company operates an overhead trolley road of some twelve miles, and, with the same power, furnishes incandescent and arc lights for the city. The generating machinery consists of two 120-kilowatt, double-current generators from the Westinghouse Electric and Manufacturing Company, of Pittsburg. The boilers are of the Babcock & Wilcox type. The special point about the generators is that they produce direct current at 550 volts for use of the cars and at the same time alternating current for the electric lighting. There are something over 1,400 incandescent lights besides the arc lights in use. High-voltage alternating current is most advantageous for a city like Seoul, where lights are scattered over long distances. The consulting engineer is a Japanese, a graduate of the Massachusetts Institute of Technology. The railway is being well patronized by the natives.



GENERATING PLANT OF THE SEOUL ELECTRIC COMPANY.

New Railroads in Mexico.

The firm of S. Pearson & Son, Limited, the contractors for the harbor works of the port and drainage works of Vera Cruz, and for the reconstruction works on the Tehuantepec Railroad, in company with Mr. Pedro M. Armendariz, of Mexico City, recently obtained a concession from the Mexican Government for the construction and operation of a railroad. This is to start from a station known as Ojapa, on the Northern Railroad of Tehuantepec, and run to a point opposite Alvarado, the terminal station of the railroad from Vera Cruz, or some other convenient point on the right bank of the Papaloapam River, touching at the towns of Acayucan, San Andres Tuxtla, and Alonso Lazaro. The concessionaries are authorized to construct and operate a branch line from the main road, starting at Alonso Lazaro and connecting with the Vera Cruz and Alvarado road at Alvarado. Within the first year twelve miles must be completed, and every year thereafter not less than twelve miles additional, and the whole line must be completed and in operation before the expiration of ten years from date of concession.

Another concession was granted to Mr. Algeron Jov, of Mexico City, or to a company he may organize for the construction of a railroad between the state of Oaxaca and Vera Cruz, starting from the southern side of the Papaloapam River, at a point opposite the town of Tuxtepec, in the state of Oaxaca, and making connection with the Vera Cruz & Pacific Railway. Three miles must be completed within the first year, and the balance within two years from the date of the concession. The motive power may be any that is approved by the government, including animal power. In no case shall foreign merchandise enjoy any freight discrimination which is not granted similar Mexican goods. The concessionary may charge other railroads which are making use of the road-bed a maximum of sixty per cent of their regular transportation rates on all freights so hauled. All construction material for road and telegraphic equipment may be imported free of customs duty. The amount of $3,000 in bonds of the consolidated public debt is to be deposited in the National Treasury as a guarantee for the fulfillment of the contract, and the principal office of the concessionary is to be in Mexico City.

An Interesting Journal of Samuel F. B. Morse—1843-1848.

THE ELECTRICAL REVIEW was fortunate to secure recently the Daily Journal kept by Samuel F. B. Morse, during his early work on the Baltimore and Washington telegraph line. This book was found in Mr. Thomas A. Edison's Library at Orange, New Jersey, and through the kindness of Mr. Edison and Mr. W. S. Mallory, of his staff, we are enabled to reproduce some of the most interesting parts. The book is eight inches by thirteen and contains about 150 pages, the diary commencing March 14, 1843, nearly 60 years ago. The book is bound in boards with a leather back and on the inside of the cover is a label reading "Jansen & Bell, Booksellers, Stationers and Law Blank Sellers, 158 Nassau St., N. Y." A label on the outside of the cover is marked "Daily Journal, &c." On the fly-leaf is the following entry:

Church at Po'keepsie,
Morning service commences
h m m
Ringing of the bell at 10.30 service 20 later
Evening service commences
Ringing of the bell at 2.30 service 20 later
If we leave at bell ringing, we arrive in season

Below this added in pencil is

		ft	inches	
Height	S. F. B. Morse —	5	9½	Dec. 1848.
	J. E. F. Morse —	5	5¼	
	Mrs. Sarah E. Morse —	5	4	

Weight.—

On the first page is a table giving the weights of copper wire of various sizes, the columns giving the feet and inches per pound, pounds per mile and the total weight for 160 miles for sizes 15, 16, 17, 18, 19 and 20.

The first entry in the book under the head of "Instructions of the Secretary of Treasury," is a letter bearing the date March 14, 1843. Then follows forty-five pages containing copies of letters sent and received by Morse up to March 20, 1844, this date being that of the last letter in this part of the book. The next page contains the memorandum in pencil:

"Returned home to Locust Grove from Washn., Tuesday, March 7, 1848 in Steamboat Columbia; arrived in Po'keepsie 12 at night; slept at Grant's Hotel and arrived at the house 10 o'clock A. M. Wednesday, March 8, 1848."

The next seven and one-half pages are under a new entry marked "Journal, commenced March 13, 1848." Under this are entries made almost every day, giving a record of the day's doings. These are in general quite brief and include a list of the letters written, visitors, trips made and the state of the weather. The entry for April 22 is quite long and is reproduced below as this gives an interesting account of a visit of Morse to New York where he examined what was reported to be a telegraph code similar to his own. In the latter part of this section of the book, the entries are very irregular, the last being dated September 9, 1848. Near the back of the book is a long list of seeds containing ninety-three items. Above this list is the entry "Seed from Mrs. Gale from U. S. Patent Office."

It will be seen from the letters copied below that this Journal was kept during Morse's early work with the Baltimore and Washington Telegraph Line. Many difficulties and troubles were encountered, but it is noteworthy in spite of all these discouragements, he at no time lost courage, but seemed rather to be spurred to greater activity by the tardiness of those to whom contracts had been let.

The following letters will no doubt prove exceptionally interesting reading:

"INSTRUCTIONS OF THE SECRETARY OF THE TREASURY.

No. 1. Treasury Department,
Washington, March 14th, 1843

Sir

I have received your communication of the 10th inst. stating the plan of operations you propose for fulfilling the object of the Act of Congress to test the practicability of establishing a system of Electro-Magnetic Telegraphs by the United States.

In general I approve the plan proposed by you. The compensation of the two assistants whom you propose to employ ought however to be fixed before they are engaged and you will report to the Department the amount or rate which you deem reasonable. Some arrangement in respect to your own compensation should also be made, and you will state the sum which you expect, either in reference to the whole undertaking, or to the time which may be devoted to it.

In order to preserve a proper check over the expenditures, and to conform to the established practice of the Department previous to the conclusion of any contract for materials, or for any work by the job, you will submit the same to this Department for its approval, and no contract will be recognised as valid without such approval. Of course this remark does not apply to the hiring of labourers by the day or the month, although the rate of wages proposed to be paid in such cases should be submitted to this Department.

An advance of a reasonable sum to enable you to commence your operations will be made on your requisition, stating the amount and object and designating the place at which you desire the same to be paid or transmitted to you, and as the operations proceed such sums will be paid from time to time, as may be necessary on similar requisitions.

As you will be held accountable for all monies paid on your application, you will find it necessary to be exceedingly careful to take vouchers in duplicate for all sums expended by you. You will be required to account monthly at least for the amounts received, and no advances or payments will be made while there shall remain any considerable sum unaccounted for. It may be well for you to devolve on one of your assistants, the duties of a disbursing agent and of keeping the accounts of the experiment.

Very respectfully
Your Obedient Servant,
Signed J. C. Spencer,
Secretary of the Treasury.

To Saml F. B. Morse, Esq.

Treasury Department
No. 2. March 28th, 1843

Sir

Your letter of the 27th inst. is received. I approve of the employment of Profs Gale & Fisher as assistants to aid you in carrying into effect the Act of Congress of the 3d of March 1843. To test the practicability of establishing a system of electro magnetic telegraphs. They will be allowed a salary of Fifteen Hundred dollars each per annum. The employment of Mr. Alfred Vail as third assistant at a salary of One Thousand dollars a year is also approved. Your own compensation will be Two Thousand dollars per annum, with the understanding that you are to receive an additional sum of Five Hundred dollars if the appropriation already made by Congress will admit of such allowance. The expenses of travelling must be limited to ten cents per mile, and for distances not exceeding Fifty miles so as to exclude the passing between Baltimore and Washington while employed on the work. A Warrant in your favour for Three Thousand dollars the amount called for in your requisition has been issued.

I am Very Respectfully,
Your Obedient Servant,
J. C. Spencer
Secretary of the Treasury.

To Prof. S. F. B. Morse.

Copy of a letter to the Secretary of the Treasury
New York April 26th 1843

Sir

I have the honer to submit for your approval a contract into which I have entered for the wire necessary for the experimental essay with the Electro magnetic Telegraph. By reference to the Voucher No 1 which I transmitted on the 10th inst. you will see attached to it my advertisement for sealed proposals for *Wire;* for the *covering of the wire* and for the *lead pipe.* The time limited for the reception of proposals expired on the 20th inst. and upon opening them, the *Benedict and Burnham Manufacturing Company of Waterbury* Connecticut were found to have proposed on the lowest and most advantageous terms for the *wire.*

Mr. Ebenezer Chase of Bloomingdale New York has proposed the most favourable terms for *covering* the wire, and I am arranging a contract with him which I will forward in a few days.

I have also arranged a contract for the *Lead pipe* with Mr. James E. Serrell of this city whose machinery for manufacturing leaden pipe has this peculiar advantage over all other modes proposed, in that it admits of the introduction of the wire with great facility into the tube *at the moment of their* manufacture, by means of an invention of my own. Mr. Serrell has also proposed on lower terms than any other. This contract I will also have the honer to forward to the Department in a few days.

The contracts for the *Wire* and its *Covering,* it is of the most importance should be first consummated as will appear from the following order of the whole work, which I have drawn out that the Hon the Secretary may the better understand my operation.

First. *Wire* for the conductors to consist of 4 lengths of 40 miles each must first be obtained equal in all to 160 miles.

Second. The 160 miles must be *once wound with cotton thread* and must receive *two coatings of Shellac varnish.* The various smaller lengths of wire are then to be soldered together in greater lengths of two miles and reeled upon 80 reels (two miles upon a reel). The 160 miles are then divided into 4 parts of 40 miles each. Each length of 40 miles is then wound with a different coloured twine to designate, in case of necessity, any particular wire in any part of the course. The 4 lengths are then laid side by side and bound together in a single cord by another winding of cotton twine. The conductors thus prepared are ready to be introduced into the Lead Pipe.

Third. The Lead pipe is next in order and cannot be commenced until the wire is prepared for being placed in it. By having the mandril *hollow* upon which the lead

pipe is formed, I can with great facility introduce the wire when prepared as above, into the pipe at the moment of its formation and in lengths of 1000 feet or more if desirable.

Fourth. After the lead pipe is completed the *Trenching* for laying it down may be commenced and not before. Contracts for this part are already in progress and will be duly submitted to the Department for the Hon Secretary's approval.

Fifth. After the trenching is completed and the conductors shall have been proved sound through the whole distance, the Stations can be determined upon both as to number and position. In the meantime, the Instruments and the Registers and Correspondents can be in progress of making and testing.

By the foregoing statement the Hon Secretary will perceive that the wire is the first article necessary for me to obtain. By the terms of the Contract, 15 days after the Contractor shall learn of the approval of the contract by the Department, there must be sufficient wire delivered to Mr. Chase (who is to cover the wire) for him to commence his operation of covering, and from that time he will be kept supplied with wire until all has been received. His work will be completed in 3 months. By the 1st of August, therefore, the wire will be ready for introduction into the pipe. The pipe can be made (introducing into it at the same time, the wire) at the rate of one mile per day. One month or six weeks at farthest will compiete this operation, but the first portion of the pipe prepared for laying down, can be delivered at Baltimore or Washington before the rest is made, so that the laying down may commence about the middle or at farthest by the end of August. The trenching may require two months but probably less for the whole route unless some unforseen difficulty occurs. I am encouraged, therefore, to believe that the Governmental essay with the Telegraph will be in a state for trial by the opening of the next session of Congress.

By reference to my original estimates of the cost for the wire and its preparation it will be perceived that I put the cost of both at six thousand (6000) dollars; By the terms of the contract the wire will cost $3400. The preparation of the wire including two additional coverings; not originally contemplated will cost $1900, making a total of but $5300. and therefore being within my estimates $700.

I beg respectfully to ask the advice of the Department on the construction I am to give to that part of my instructions which says "previous to the conclusion of any contract for materials, or for any work by the job, you will submit the same to the Department for its approval, and no contract will be recognised as valid without such approval". As the terms "any materials" and "Any work" admits of a very close construction, if rigidly adhered to, my operations would be much embarrassed. I know not to what extent I am left at discretion to have executed a great deal of small work, and the purchase of small materials connected with my experiments, and how far I must submit the details both of work and price to the department before I am legally authorized to proceed. I am desirous on the one hand to be properly observant of instructions, but on the other hand fear to trouble the department with superfluous details. Believe me sir, with sincere respect, Your most Ob Sert.

Samuel F. B. Morse.

Hon. John C. Spencer,
Secretary of the Treasury."

Copy of a letter to the Secretary of the Treasury.

New York April 29th 1843

Sir

I have the honor to submit for your approval a contract entered into by me in behalf of the United States with Mr. Ebenezer Chase for *covering* the *wire* for the Telegraphic experiment. Mr. Chase, as I observed in my last communication to the Department, has offered the lowest and otherwise most advantageous terms for this part of the work.

I also enclose for the Honorable Secretary's approval a contract for the *cotton twine, with which to cover the wire*, entered into by me in behalf of the United States with Messrs. Benson & Godwin of Paterson, New Jersey. The blank to be filled in this contract will not exceed 24 cts. I shall know on Monday 1st of May, and am hoping to fill it with 22 cents or even less.

I have the honor to be with great respect,

Y Mo Ob Servt

Saml F B. Morse

To the Honorable
John C Spencer
Secretary of the Treasury ..
..
of the United States ..

New York May 1" 1843

Sir,

In my letter of the 29th ulto. accompanying the contracts for the *twine* to cover the Telegraphic Wire and the *expenses of covering*, I left a blank in the former which I observed was to be filled with a sum not exceeding 24 cents pr. lb. I have this moment heard from Paterson and am enabled to fill the said blank with 22 *cents*. This varies the expenses of *Preparation of the Wire*, as given in my letter to the Department of 26th ulto. from $1900 to $1910—making the contracts for this part of the work $690. less than the original estimates instead of $700. as therein stated.

I have the honor to be Sir
With great respect
Y Mo Ob Sert
Sam F. B. Morse.

..
To the Hon. J. C. Spencer ..
Secy. of Treasury of U. States ..

No. 4. Copy from the Secy of the Treasury

Treasury Department May 2d, 1843.

Sir

Your letters of the 26 and 29th ulto. with their enclosures are received.

In reference to the contracts for the supply of copper wire, I should prefer its being made in the name of individuals rather than in that of a corporation if the Company mentioned be one. There appearing to be a want of explicitness in regard to the payments to be made under the contract sent by you I have had a form of one prepared here which is enclosed, and may be conformed to in others with such modifications as may be needed to meet the particular case.

You are authorized to make the contract for the supply of copper wire, and also the one for covering the wire at the prices and on the terms and conditions stated. The contracts for the cotton twine cannot be authorized until the Department is furnished with the prices at which it is to be supplied.

In reply to the inquiry in your first mentioned letter, I would observe that the instructions heretofore given do not contemplate contracts for materials of small value, of work of trifling cost, say materials costing more than One hundred dollars and work of any hands for more than a month should be submitted, and all others reported to the Department.

I am Very Respectfully,

Y. Ob. Servt.,
J. C. Spencer,
Secy of the Treasury.

Prof. S. F. B. Morse ..
..
New York ..

No. 5.

Treasury Department May 4th, 1843

Sir, You are authorized to enter into the contract for the supply of Cotton twine to cover the Telegraphic wire at the rate of Twenty two cents per pound the price stated in your letter of the 1st inst.

I am very respectfully,

Yr. ob servt,
J. C. Spencer
Secretary of the Treasury.—

Prof. S. F. B. Morse, N. York.

COPY

New York May 6th 1843

Sir

In obedience to the instructions received from the Department on the 4th inst. in answer to my inquiry respecting the intent of certain portions of former instructions, I have the honour to submit that I had given orders early in April for the immediate making of the *eighty reels* necessary for the reeling of the wire for the Telegraph in the various stages of preparation at the rate of two dollars each, making in the aggregate One hundred and sixty dollars. These reels are nearly completed. They will be ready just in season for the first wire on its delivery. This is the only single order for "materials" that I had given of an amount beyond "One hundred dollars".

I have also a man in my employ to assist in the laboratory, and in the laboring services of my experiments on wages at seven dollars per week. As he will probably be retained more than a month, his case perhaps comes under the denomination of "work of hands for more than a month.

These I would, therefore, submit to the Honorable Secretary for his sanction, and in future similar cases will be respectively submitted and reported in compliance with the instructions of the Department.

I also have the honor of enclosing a copy of the contract for *Covering the Wire* approved by the Department on the 2d inst. and now duly executed by the parties agreeably to the form sent me by the Department.

With great respect Sir
Yr Mo Ob Sert,
Saml F. B. Morse

To the Honorable
John C. Spencer
Secretary of the Treasury of the U. States

New York May 17, 1843

Copy to F. O. J. Smith

Dr Sir

Yrs of the 27th April I have this morning recd. enclosing the Contracts for trenching. I have examined the contracts and I must say I am not exactly pleased with the terms. If I understood you right before you left for Boston you were confident a contract could be made far within the estimates given in to Govnt. and I had hoped that something could be saved from that estimate as from the others, so as to present the experiments before the country in as cheap a form as possible. I have taken a pride in showing to Government how cheap the Telegraph can be laid, since the main objection and the one most likely to defeat our ulterior plans is its great expense. I have in my other contracts been able to be far within my estimates to Govnt, and I had hoped to be able to present to the Secy. the contract for trenching likewise reduced. There are plenty of applicants here who will do it for much less and one even said he thought for one half. I shall do nothing in regard to the matter until I see you. I hope I may see you before this reaches you, as there ought to be no further delay in completing our arrangements with the R. R. Co., and I am anxious to go over the road personally before any contract is agreed upon.

In gr haste but with esteem Yr friend

Sam F. B. Morse.

P.S. The Department has furnished me with a *form* to which I am compelled to conform in making my contracts, different from yours.

Copy.

New York May 25th 1843

Sir.

I have the honor to report to the Department that the preparation of my wire for the Telegraph is in rapid progress. On the 22nd inst. I engaged Ebenezer Chase junr. to solder and cover the joints of the wire at $1.25 pr. *diem* for six days in the week, and Michael Quinn a boy at $1.25 pr. *week;* and this day I have engaged Lewis Wood at $6. pr. week to assist in the soldering and covering in the same capacity as Benjn F. Taylor previously reported and approved. This additional assistance is required to give effect to an additional machine put in operation by Mr. Chase which expedites the whole process of preparation.

I remain, Sir Wi the great respect

Y. mo. ob Servnt.

Sam. F. B. Morse.

To Hon. J. C. Spencer,
Secretary of Treasury of U. States.

New York June 13, 1843

Sir I intimated in a previous communication to the Department that from my experience in the preparation of my Telegraphic wire, I should "need more varnish and less cotton" than originally estimated which would produce an economy of perhaps some 500 dollars. I find that I can dispense entirely with the colored cotton 1800 lbs at 22 cents pr lb 396 dollars and 600 lbs at 14 cents pr lb 84 dollars. The use of colored varnish dispenses also with the labor of the second winding with cotton which is contracted for at $2.75 pr mile or $440. for the whole distance making an aggregate of retrenchment of 920 dollars. The additional expense for varnish and labor is, however, to be deducted from this sum. My object in stating these circumstances to the Department is to request permission to dispose of the 2400 pounds of cotton. The colored thread having now advanced in price may be sold not only without loss but even to advantage.

I have the honor to be

Most respectfully,

Yr Mo ob servt

S. F. B. Morse

To the Hon John C. Spencer
Secy of the Treasury.

New York August 10th 1843

Sir

I have the honor to transmit herewith my fifth monthly report of expenditures under the act of the late Congress for testing the practicability of establishing a system of Elec Mag Telegraphs for the United States.

I also take this opportunity of communicating to the Honor. Sectry the result of the experiment made on the 8th inst. with the prepared wire in one continuous line of 160 miles Professors Renwick, Draper, Ellet & Schaffer, were present by invitation. Professors Sillimans, Henry, Toorey & Dr. Chilton and other Gentlemen were also invited, but were prevented by official duties from attending.

In the letter to the Hon Secry dated March 10th 1843, in which I proposed my general plan, I have this remark, speaking of the wire after its innitating preparation should be (is) completed, "many interesting *experiments* bearing upon the general result can then be tried before the wire is enclosed". The experiments alluded to were tried on Tuesday with perfect success. I had prepared a Galvanic Battery of 300 pairs in order to have ample power at command, but to my great gratification I found that 100 *pairs* were sufficient to produce (through the whole distance of 160 miles) all the effects I desired. It should be observed that the 160 miles of wire are to be divided into four lengths of 40 miles each forming a four fold cord from Baltimore to Washington, 2 wires form a circuit, the electricity therefore in producing its effects at Washington from Baltimore passes from Balt to Washon and back to Balt of course travelling 80 miles to produce its result, 160 miles therefore gives me an actual distance of 80 miles, double the distance from B to W. The result therefore of my experiment on Tuesday is that a battery of only 100 pairs at Washington will operate a telegraph 80 miles distant with certainty without requiring any intermediate station.

Some careful experiments on the decomposing power at various distances were made from which the law of propulsion has been deduced, verifying the results of Ohm and those which I made the summer of 1842 and alluded to in my letter to the Hon. C. G. Firris published in the House Report No. 17 of the last Congress.

The practical inference from this law is that a telegraphic communication on my plan may with certainty be established across the Atlantic! Startling as this may seem now, the time will come when this project will be realized. The wire is now in its last process of preparation for enclosing in the lead pipe, which will be commenced on Tuesday the 15th inst.

I have the honor to be with

Sincere respect

Your Ob ser

S F B Morse

Supt of Elec Mag Tel

Hon. John C. Spencer
Secy of Treasury

(To be concluded.)

Preparations for Electrical Exhibits at the Louisiana Purchase Exposition in 1904.

WE PRESENT in this issue views showing the actual progress in construction of the Electricity Building of the Louisiana Purchase Exposition in St. Louis. Notice has come to us from time to time indicating that the executive officers are making most persistent and determined efforts to push the construction of the exposition buildings with that rapidity which is necessary to carry with it a definite assurance that the exhibit palaces will be entirely completed and equipped with fire protective apparatus and all facilities early in the fall of 1903.

Fig. 1 shows the progress of construction work on the Palace of Electricity during the middle of the summer, the view having been taken on July 22. The view is taken from what is termed Art Hill, looking over across to the Administration Building, the large stone structure seen in the centre of the horizon line, and surmounted by the Tudor towers. This building, with others now in the process of construction, is built on the new site of Washington University, and will ultimately be occupied by the faculty and students of the university. Until the close of the fair, however, these buildings will form a part of the exposition scheme. At the present time the buildings are used by the administrative officers, including all of the departments of the division of works, of the division of exhibits, of the division of concessions and of the division of exploitation. Never before have the officials engaged in the building up of an exposition been so comfortably and elegantly housed during the preexposition period. For some months now the electric lighting and heating equipments have been installed and in operation under the supervision of the division of works.

At the left of the Administration Building, in the background, stands one of the Washington University dormitories, and it is back of this building, between it and the forest, that the exposition athletic field will be laid out, on which it is probable the Olympian games will be held in 1904. Over this track also has been arranged the course over which the contests between competing dirigible balloons and aeroplanes will be held, for prizes aggregating something over $100,000.

Just back of the Administration Building the Hall of Congresses is in the process of construction. In this hall, as has lately been announced, it is the intention of the exposition to inaugurate a series of international congresses, covering the entire field of human thought and endeavor, prominent among which it is hoped and expected will be an international congress of electricians.

The foreground of the picture gives a very good idea of the preliminary stage in the construction of the exposition buildings, as the same general plan has been followed in all of them. After the uprights are erected and given a suitable footing on a series of heavy timbers embedded in the ground, wooden trusses are elevated into position and suitably erected in place, to carry the roofing and skylight covers. Timber has been used in the construction of these buildings, reenforced by generous use of iron bolts and tie-bars, rather than a complete iron construction, owing to the difficulty of securing iron as rapidly as it would be required. More than this, it is claimed, and apparently with good justification, that heavy wooden construction will be less liable to collapse and be better able to

longer withstand the ravages of fire than would an iron construction of the class that was used at Chicago, and which was so rapidly destroyed by the fire which marred the end of that exposition.

To guard against the spreading of fire in the exhibit buildings, a very elaborate system of high-pressure water mains has been carried along the walls and under the floors, as well as over the roofs, of all of the buildings, and numerous hydrants with hose attached will be distributed and arranged to command the important points. With these precautions, supplemented by the excellent fire brigade with complete engine equipments and engine houses which the exposition has provided, it is felt that manufacturers are afforded ample protection in exhibiting their products.

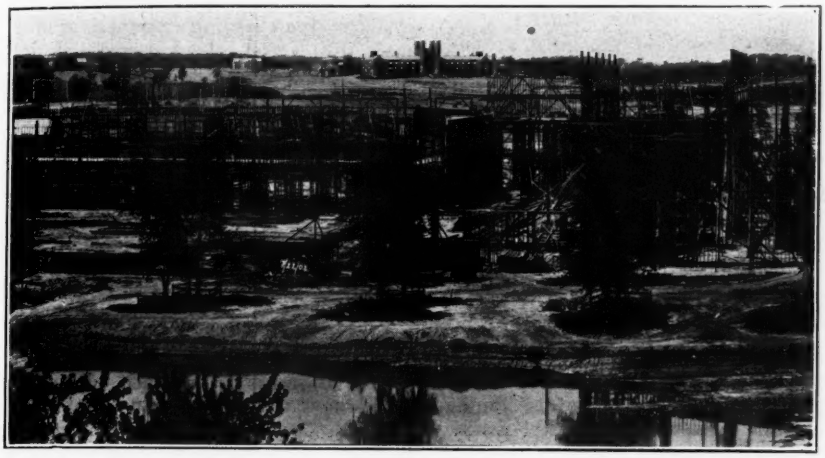


FIG. 1.—VIEW FROM ART HILL TOWARD ADMINISTRATION BUILDING, LOUISIANA PURCHASE EXPOSITION.

The second view shows at the left the east, and at the right, the north wall of the Electricity Building. The west exposure is that which is seen in Fig. 1. The whole of the north wall is not visible, owing to the fact that the building is an irregular pentagon, the north corner of which is hollowed to provide a grand and imposing main entrance to the building. In fact, the building will carry a greater load of sculptural ornamentation than will any other on the exposition grounds.

Over the main entrance the building will be raised to a considerable height, and follow the general lines of construction shown over the side entrance at the centre of the left-hand side of Fig. 2.

The towers at the four corners are to be surmounted by figures allegorical of heat, light, electricity and magnetism, while those at either side of the main entrance will typify the genius of invention and commercial application.

Out in front of the main entrance is to be placed a heroic statue of Joseph Henry. Joseph Henry is given this position of prominence in recognition of the talents he displayed which mark him as the first American electrician, and in appreciation and courteous recognition of the generous action of the foreign delegates to the international congress of 1893, when to the unit of self-induction Henry's name was given. Opposite the entrance on the east side of the building will, in all probability, be placed a heroic statue of Jefferson, on the west side a statue of Volta, and on the south side a group allegorical of the Louisiana Purchase. For the statues of other eminent electricians, six places are provided between double columns in the façade of the eastern exposure, as these columns are so situated as to provide ample space for the placing of statuary between each pair.

The building itself will be made resplendent by other allegorical groups of statuary placed over the entrances which flank each of the towers, as well as in prominent points about the elevated pediments over the side entrances.

As regards the exhibits that have thus far been offered to this department by the manufacturers of electrical machines and appliances, we have recently learned that the situation is most gratifying. Apparently sixty-five per cent of the exhibit space accredited to American exhibitors is now applied for, and among the exhibits, covering which complete specifications have been submitted, we understand there are several both larger, more comfortable and interesting than have ever been common to the electrical features of the exhibits in any previous exposition.

The desire of the department, which has been earnestly put forth on numerous occasions, to receive only live exhibits, has been met in most generous measure by the manufacturers, the demonstration of processes in the manufacture of dynamos, motors, incandescent lamps, telephones, magneto generators, arc lamps, arc lamp carbons, wire, cable, etc., will be shown in a broad way. In addition to these, we are advised that the department's plans cover the showing of practically every known application of electricity, and the development of the exhibits along lines which give them special individuality.

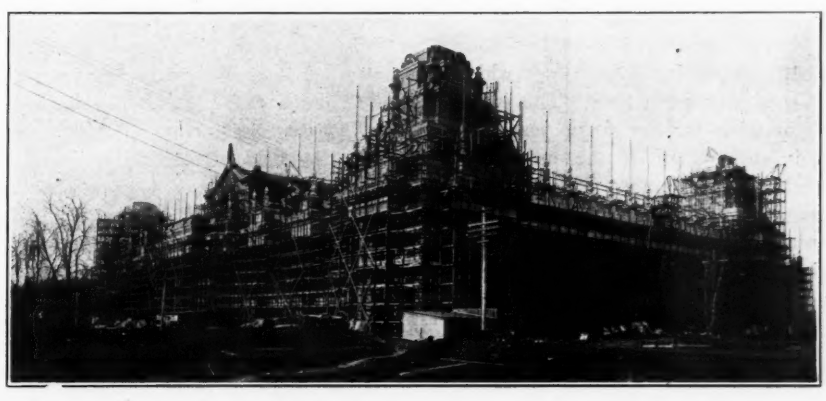


FIG. 2.- ELECTRICITY BUILDING, LOUISIANA PURCHASE EXPOSITION.

Utilizing Lodore Falls, Cumberland, England.

Mr. J. S. Harker has completed arrangements for utilizing Lodore Falls to supply electricity for lighting a hotel and other purposes. The work has been planned in such a way as to avoid interference with the picturesqueness of Lodore and its surroundings. The falls will remain intact, no water being required except during the hours of darkness, and in daytime will continue as at present.

Telephone Progress in 1902.

By a Telephone Engineer.

THE gain made by the New York Telephone Company is typical of the whole industry. For 1902 the net gain in the two boroughs of Manhattan and the Bronx was 30,338, making the number of telephones in service and under contract on January 1 in these two boroughs 105,388. Every city in the United States shows a similar condition. There is today a universal recognition of the utility of the telephone. This is particularly the case in office buildings and hotels. In the latter instance it is entirely doing away with the speaking-tube service.

In the manufacture of apparatus, while the most recent exhibits show slight modifications and refinements in construction, the principles have advanced but little, and no decided change has lately been brought about in either the construction or manipulation of telephone apparatus. The manufactures of this class of apparatus, however, for the year 1902 represent the very handsome total of some $20,000,000.

With the opening of new exchanges in all of the larger cities, and the turning over to central energy systems, there has come the inevitable and desired extension of lines. This is particularly with reference to long-distance through lines. While on overhead lines successful articulation is comparatively easy for considerable distances, the limit of cable transmission is generally within the boundaries of a large city. The desirability, however, of making use of telephone cables in subway construction is conceded, and it is inevitable for under-sea and trans-oceanic communication. The technical difficulties to be overcome will lead to a supreme effort in the perfecting of cables, the manufacture of which will undoubtedly receive great stimulus.

The successful application of the Pupin loading system would bring about a new development in long-distance telephony. That this is entirely within the limits of possibility seems evident from recent tests made by the Siemens & Halske Company, in cooperation with the German Imperial Postal and Telegraph Bureau. The principal difficulty encountered in long-distance telephony and telegraphy by means of the quick electrical impulses characteristic of this service is the deleterious defect due to electrostatic capacity in long overhead lines, which becomes more pronounced in cables. By increasing the self-induction of the line the intensity of the charging current is diminished, with a consequent decrease in the heat loss and the obviating of the necessity for greater cross-section in the conductor. This is what, in theory, the Pupin system stands for, and the above tests have resulted in demonstrating a really practical value for it.

The London-Brussels cable, which was scheduled to be in operation about this time, has been entirely laid. There are, however, a number of details which are to be worked out, and it is now announced that there will probably elapse a couple of months before it is in practical commercial operation. Another new telegraph line from Germany to Great Britain has been completed, and a direct line has been opened between Liverpool and Paris. Negotiations for the extension of the Anglo-French telephone service between provincial towns in both countries have also been made. It is expected that Russian and German postal authorities will soon connect Berlin and St. Petersburg, making a line of over 1,000 miles in length.

Electrical Patents in 1902.

By E. G. Siggers.

THE total number of patents issued from July 28, 1836, to December 13, 1902, is 717,520, of which 27,775 were granted in 1902. This is the highest number for any single year, and is an infallible sign of the prosperous condition of the country. The amount of thought and study, experiment and effort which these figures evidence is inconceivable. In some instances, an invention may have been evolved and completed in the twinkling of an eye, the flash of a thought, but with the great majority the completed improvement, process or machine represents days of long and painstaking investigation.

It would be practically impossible to ascertain with any great accuracy the number of electrical patents that form a part of the 27,775 issued. The use of electricity is now so very general that there is probably not an art or science but which has been improved by its employment. As a large number of these patents do not show on their faces or by their titles the use of electricity (it being employed incidentally in many cases), an examination of a multitude of the inventions would be necessary. A general idea may be gathered, however, by taking those issued for one week. For instance, in the last week of 1902 there were 574 patents granted, and a rather hasty examination shows that at least ninety-eight of these relate to the field of electricity, though, as already stated, many more probably employ it incidentally. Among this number, the General Electric Company, as usual, stands first, controlling nineteen patents which are divided among fifteen inventors. The Kellogg Switchboard and Supply Company, of Chicago, Ill., has four, the Sprague Electric Company one, while Mr. John Stone Stone has seven on as many improvements in his wireless telegraph system. The Westinghouse Electric and Manufacturing Company has four patents to its credit, while George Westinghouse is listed as the assignee of two patents on improvements in the Nernst lamp. Multiply these figures by fifty-two and a very general idea may be gained of the activity in the field of electricity. No revolutionary inventions of a startling nature appear to have been made during the past year, the work having been confined mostly to perfecting, or making practicable, ideas already given to the world. Of course in many cases these subordinate novelties have been of the greatest importance, and the ELECTRICAL REVIEW, with its usual promptness, has made its readers acquainted with the same. Great strides have been made in transmission of messages without the use of wires. The idea was first presented to the Patent Office by Mr. Mahlon Loomis, of Washington, D. C., who, on July 30, 1872, obtained a patent on a system of this character. From then until 1886 nothing appears to have been done, when on October 5 Mr. Amos E. Dolbear, of Somerville, Mass., was granted protection on his system. The patents on this branch alone now number 129, and seventy-one were issued in 1902. Of this seventy-one, Mr. Harry Shoemaker, of Philadelphia, was granted twenty-four; Mr. John S. Stone, of Boston, Mass., sixteen, and Mr. Reginald A. Fessenden, of Manteo, N. C., fifteen. That the Nernst or glower lamp has proven fascinating is evidenced by the fact that 109 patents now represent this branch in the Patent Office. Mr. George Westinghouse owns the greater number, including those granted to Mr. Nernst. Great activity is likewise being shown in systems of electrical distribution, especially those relating to alternating currents, also in armature windings, and indeed in all the multitudinous details incident to the art in general.

Electricity on Trunk Lines.

By Dr. Louis Duncan.

THE most important problem for electrical engineers to-day is the substitution of electricity for steam on trunk lines. The general opinion seems to be that the problem will be solved by the use of alternating currents, and several such systems have been proposed and some of them have been experimented on.

Any one making a careful study of any particular trunk line problem will come to the conclusion that continuous currents are not applicable to this work. Two years ago Dr. Hutchinson and myself studied the question of substituting electricity for steam on the mountain division of the Baltimore & Ohio Railroad between Cumberland and Grafton. A preliminary report had been made by another engineer on this proposition, and a system employing direct current for the motors, supplied from rotaries in substations, was advocated. On carefully studying the problem, however, we found that this solution was impossible and that the plan proposed had not been carefully enough worked out to show the impossibilities. The congestion of freight traffic and the heavy units involved make the capacity of the substations compared with the average total power required excessive, while the amount of copper necessitated by these conditions is prohibitive.

As far as alternating currents go, there are four propositions at present being experimented on, or practically used. The first of these is the three-phase alternating-current system, which has especially been developed by Brown and Boveri and by the Ganz company. As at present installed there are two conductors above each track, the rails acting as the third leg of the circuit. As high potentials must be used to make the system economical, we have the very unfavorable condition of two overhead conductors at a very serious difference of potential, placed near each other over the track.

The plan used on the experimental road at Zossen, where the three wires are strung above one another in a vertical plane, presents such difficulties in switching as would make it inapplicable to any practical system of trunk line operation. Besides the difficulty to be apprehended from the conductors, there are difficulties in the regulation of motors and in the unbalancing of circuits, provided the rails are used as one leg.

The second system is that proposed by the Oerlikon Company. They intend to use a single-phase current running a synchronous motor on the locomotives, this in turn driving a continuous-current dynamo which supplies current to the motors on the axles. The regulation is obtained by changing the field current of the dynamo.

The third plan, proposed by Mr. Arnold, is to use a single-phase synchronous motor compressing air when the power required is below its normal capacity, and being assisted by an air engine when the demand for power is above the capacity of the motor.

A fourth system, of which we have few details, is that of the Westinghouse company, which uses single-phase alternating currents operating series motors with laminated fields. If this system can be worked out in practice and if it avoids the difficulties that have been considered inherent in motors of this type, it presents advantages over the other systems proposed, both in simplicity and in adaptability to various conditions. It is to be hoped that the line between Baltimore and Washington will demonstrate the value of this system.

Looking over the field, then, the tendency of development is in the direction of supplying power to the locomotives by alternating currents instead of continuous currents, and by a single-phase system instead of any multiphase system. In this way a very high potential can be used on the line, and it enables a large section of the road to be fed from a single station, thus giving a comparatively steady load and a minimum equipment.

Growth of the Storage Battery in 1902.

By Charles Blizard.

FROM the time of the first installation of the modern type of storage battery in 1894 and 1895, the rapidity and extent of its adoption have been exceptional, but the development of its use during the past twelve months never has been equaled in its history.

The greatest growth has been naturally in the installations for railway service, which during the past year have increased fifty-six per cent. In central station plants there has been an increase of thirty-one per cent and in isolated plants of twenty per cent. These percentages indicate the increase during 1902 over the aggregate number of plants installed since 1894.

It is fair to assume that this growth is due in a large part, at least, to the success of the early installations which have been in service for a sufficient length of time to enable the operators to obtain, from their own experience, comprehensive data on results.

This assumption is confirmed by the fact that during the past year several of the largest contracts for storage batteries ever awarded have been placed by companies which were among the earliest and largest purchasers and which have had, therefore, the most extended opportunities to judge the merits of the battery and its value as an auxiliary.

The increasing use of the storage battery has developed a more intimate knowledge of its ability to add to the flexibility and reliability of a system of electrical distribution, and the result is shown in the more profitable methods of operating batteries.

Power-house attendants who have charge of batteries have obtained closer acquaintance with their characteristics, and there is a notable improvement in the care being given them.

Batteries have played an important part during the past year in the readjustment of power schemes made necessary by the numerous consolidations of railway interests.

In former years batteries were considered to be available only for the largest systems; there has been a radical change in this view and batteries are now being installed by the smallest, as well as by the largest, companies.

The improvements in storage batteries during the past year have contributed to an increase in reliability and durability and to simplified operation.

The American Pacific Cable.

On the evening of January 1 the first section of the Pacific cable, which is being laid by the Commercial Pacific Cable Company, was completed. This extends from San Francisco to Honolulu, and is about 2,300 miles long. The shore end was laid and connected to the land end at San Francisco on December 12. The latter is said to be the best land cable that has ever been laid. It contains four conductors insulated with gutta percha, lead sheathed, and heavily armored and is six and one-half miles long. These sections of the cable were made by the Okonite Company, New York city. The deep-sea portion was manufactured by the India Rubber and Gutta Percha Construction Company, of England, and was laid by their steamer, Silvertown. It also contains four conductors.

In starting the work, the Silvertown approached as closely to the shore as possible and floated the shore end to land, buoying it up by means of large air bags. This was done while a strong tide was setting in, which assisted materially in carrying the end to the shore. Connection was then made with the land cable, and after preliminary tests the Silvertown started on the voyage. Mr. Clarence H. Mackay, Mr. George G. Ward, Mr. W. H. Baker, Mr. E. C. Bradley and Mr. Charles Cuttriss, of the cable interests, and Mr. W. L. Candee, of the Okonite Company, were present at the ceremonies connected with the laying of the cable, and a large and enthusiastic company of San Francisco people attended.

The voyage to Honolulu was made at an average speed of seven and one-half knots. The cable ship was beset by bad weather and heavy seas, which retarded the work considerably and at times endangered the cable. The vessel reached her destination on December 26, and the deep-sea end of the cable was buoyed in Molokai Channel at 5.20 o'clock that morning, when the Silvertown proceeded to Honolulu, where it was met in the harbor by welcoming delegations.

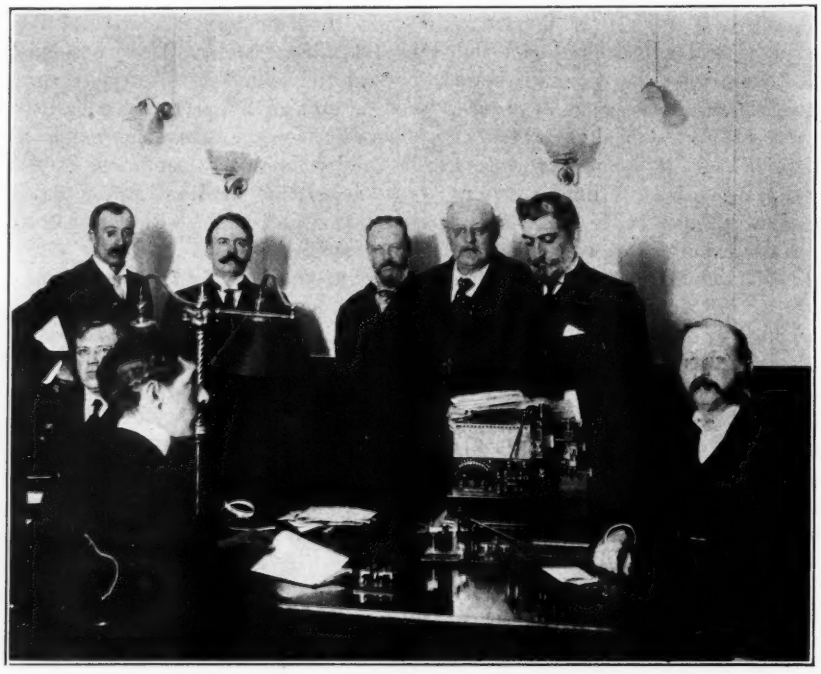
The stormy weather continued for six days, making it impracticable to complete the work. However, the shore end was laid on December 27 without a hitch. The cable was hauled up on land at San Souci Park, about six miles from Honolulu.

On January 1 the wind abated and the sea became quiet enough to proceed with the work. The deep-sea cable was picked up successfully at 3.44 P. M. Connections were made with the testing room, and a call to California was quickly answered. The shore connection was made, and four hours were spent in testing the recently laid cable and allowing it to acquire the temperature of the ocean. At 8.40 P. M. (Honolulu time), the first call was received from San Francisco. Messages were sent to President Roosevelt, announcing the completion of this part of the work, and conveying the greetings of the people of the territory of Hawaii. The cable was opened for commercial business on Monday, January 5.

The second section of the cable will reach from Honolulu to Midway Island, about 1,300 miles, and will be laid by the Silvertown as soon as it can be brought out. The third section will extend from Midway Island to Guam, and the last section from the latter island to Manila. These will be laid as rapidly as possible, and the company expects to have the whole cable completed by July 4. Over 3,500 miles of this section have already been manufactured.

It is difficult to estimate the value of this undertaking, which will put us in close communication with our Pacific dependencies and the East. Great credit must be given to the late John W. Mackay for his management and ability in starting this great enterprise. Since his death the work has been continued ably by his son, Mr. Clarence H. Mackay, president; Mr. George G. Ward, vice-president, and other officials of the Pacific Cable Company.

The photograph which we reproduce shows a group of the company's officials and cable experts, taken at the San Francisco station.



W. F. Harrington. Charles Cuttriss. G. G. Ward. L. W. Storror.

GROUP AT SAN FRANCISCO STATION, COMMERCIAL CABLE COMPANY.

The American Association for the Advancement of Science.

The annual meeting of the American Association for the Advancement of Science and of the American Physical Society were held in Washington, D. C., during convocation week, from December 29, 1902, to January 3, 1903. Sessions of Section B, Physics, were begun on Monday, December 29. The American Physical Society held its annual business meeting on Wednesday, December 31. A number of splendid papers were read by prominent scholars from different sections of the country. During the week many interesting and profitable visits were made to the new National Bureau of Standards, the astrophysical observatory of the Smithsonian Institute, the Naval Observatory and the Coast and Geodetic Survey. Many physicists attended the sessions at the Weather Bureau.

Overhead Trolley System for East London, England.

The Highways Committee of the London County Council has decided to adopt the overhead system of electric traction for the tramways to be constructed in the East End of London. The new lines, which are to traverse the eastern part of the metropolis, are the first of the tramways north of the river to be undertaken. The reason given for the decision is that the extension of the Metropolitan Railway along Mile End Road does not admit of conduits being constructed, as the girders which, with their jack-arcing, form the roof of the tunnel come too close up to the surface to enable the required depth to be obtained.

THE REQUIREMENTS OF MACHINE TOOL OPERATION, WITH SPECIAL REFERENCE TO THE MOTOR DRIVE—I.*

BY CHARLES DAY.

The paper that I have prepared for this evening may seem to some rather inappropriate for a gathering of electrical engineers, but we have been so impressed with the fact that the majority of engineers who make a study of shop equipment fail to appreciate the importance of a thorough understanding of its conditions and requirements, that an outline of this field as it has come before our notice may not be out of place.

I want you to feel that I am constantly speaking in reference to the motor, the course of reasoning pursued naturally leading to electrical transmission, but opposed to the hasty and illogical advocacy usually put forth.

The industrial development of the past few years has revolutionized so rapidly the methods of manufacture in every field that we are apt to lose sight of great advances that have been made. It is, therefore, well at times to briefly review the conditions along the lines we are following, as an intelligent view of the problem as a whole must be had before we are in a position to analyze and discuss it in detail.

It is not my intention in the present paper—which will be devoted to the machine shop—to consider the subject from an historical standpoint; an entire paper could be written on this. I will briefly compare the essential differences in equipment and duties demanded of the workmen, which have come about during the past few years.

Long ago when the blacksmith labored over his anvil drawing out, lapping and redrawing many times a bar of steel that was to result in a sword blade of remarkable strength and flexibility, his entire efforts were bent upon arriving at a job of perfection, no matter how long it took to reach the result. Time was a secondary consideration.

To-day in the industrial field, quality alone means little; the time required to arrive at a given result is the true gauge of worth.

The machine shop as a whole, just as in detail, is but a means to an end, and depends upon the development of other fields of industry for its existence. Consequently, if we go back before the railroad, the steamship and numerous other epoch-making discoveries, we find it in an extremely crude state. In fact, none would be found of the machine tools so familiar to-day to all interested in this problem. Tool steel was of the crudest character, the basic principles of modern shop practice not conceived, the only aim to eventually get the job done.

The shop is, however, the keynote of all manufacturing; these conditions were not allowed to exist for long. Improvements were introduced very slowly at the start. As an example, we can cite Mushet's discovery of air-hardening steel, not generally adopted or appreciated until years after its discovery. This does not seem strange, however, if we look back on conditions existing at that time and see how little knowledge of the elements at issue or understanding of the possibilities was to be had. In fact, it is these things that mark the differences between old and new shop practice, intelligent and scientific methods replacing the crude and faulty systems and conclusions so characteristic of a few years ago.

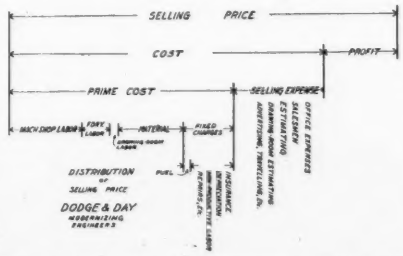


FIG. 1.—GRAPHICAL DISTRIBUTION OF SELLING PRICE.

In the machine shop of a short time since, in fact in many of to-day, no one can be found who knows anything of cutting speeds of which different brands of tool steel will permit, the size of cuts that the various machines will pull, the feeds that are or should be used and so on. In a shop of this character one usually finds the tool steel and machines ordered through a purchasing department by men who do not understand the first thing about the requirements to be fulfilled or the relative merits of different machines. It has never occurred to such men to study or analyze the conditions, and what seems to be economy to them, in many cases, represents a most extravagant policy.

Intelligent analysis is the only method to pursue in work of this kind, but, as stated in the beginning of this paper, we must ever keep before us a broad view of the subject, that the relative importance of the various factors be evident. It is easy to become so interested in a given detail—the motor drive as an example—that its true position in the general scheme is entirely lost sight of—our judgment, as a consequence, of little value.

This fact has been impressed upon us so often when aiming at more efficient production, analyzing the conditions in the shop and studying the various methods employed, that I feel we may dwell upon it here.

As example, we will consider a plant composed of foundry, machine shop and office, manufacturing complete machines from the crude material.

The only way the relative data can be quickly grasped is by presenting it graphically to the mind; the chart, Fig. 1, may be taken as the distribution of cost of the finished product of the plant in question.

When the data can be compared in this way the relative importance of each factor can be realized at a glance, the advisability of an expenditure of energy or money in any direction readily determined. In this connection I wish to refer to the indirect savings for which we must ever be alert. For example, a concern manufacturing a standard article may, by a reduction in first cost, make possible a large increase in sales, while in a works of different character no such advantage would be gained.

The value of the graphical method of presenting data of all kinds is too well understood to need further comment here; it may be of interest, however, to some of you to know that we have frequently found it advantageous to lay out executive charts or the course the mail pursues in passing through the departments of a large organization in this way.

We may have seemed to digress somewhat from the point at issue, *viz.*, the application of the motor in the machine shop, but we are anxious to impress upon you the importance of a thorough understanding of the requirements and conditions before entering upon details with which you are more or less familiar.

Referring again to the graphical distribution of the selling price, the part that is of interest to the shop manager is the prime cost; it should be his object at all times to lower this figure. It is impossible by guess to determine what course to pursue, thorough study of all conditions of the particular case in hand being absolutely essential if we desire to approach an efficient result.

The fact that a shop exists is proof that the articles manufactured are needed, and it must always be the first consideration to fulfill this need to the best advantage. In other words, we must not enforce economy in the shop by sacrificing vital features in the product.

(To be continued.)

* Paper read before the New York Electrical Society, December 17, 1902.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Ringer.

In the accompanying illustration is shown a new ringer, recently placed on the market by the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., and Chicago, Ill.

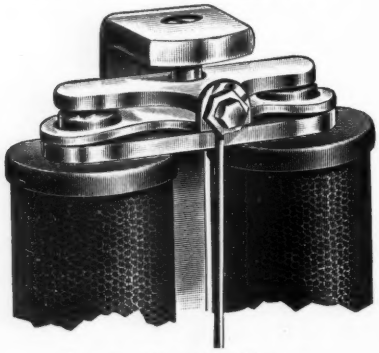


FIG. 1.—COMPLETE RINGER.

The ringer is said to embody new and simple features in the matter of adjustment. In Fig. 1 is shown a complete view, while in Fig. 2 is shown a view of the armature end of the ringer, which is almost self-explanatory as regards the manner in which adjustment is made. A word of explanation, however, may not be amiss.

It will be observed upon examination that a screw passes through the permanent magnet, armature, armature

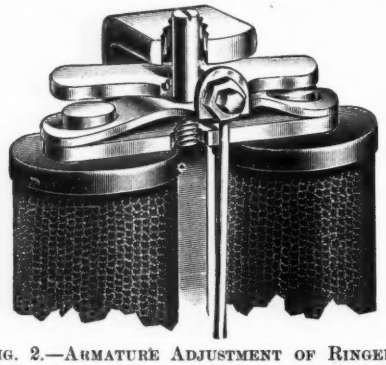


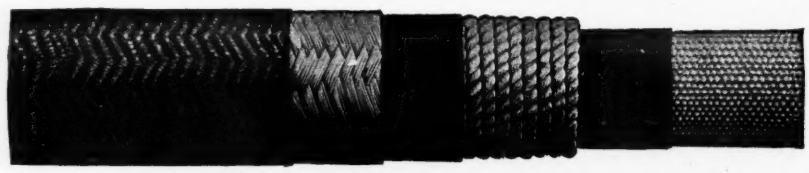
FIG. 2.—ARMATURE ADJUSTMENT OF RINGER.

frame support, and is threaded into the armature yoke. By turning this screw, a shoulder on the screw is made to engage against the frame, which supports the armature and this, being made of spring steel, allows it to be pressed downward, thus bringing the armature nearer the cores, while the turning of the screw in the opposite direction allows the distance between the cores and armature to be increased. This adjustment is very simple and requires the turning of only one screw, which may be done as easily after the ringer is mounted in a telephone as before.

Fireproof Fiber Conduit.

The interior of the tube is made of heavy canvas duck thoroughly fireproofed by an approved process, this being covered with a slow-burning, flexible weather-proof compound, over which is spirally wound hard-twisted cable cord, thoroughly fireproofed. The intersections between the cord are then filled with a special compound, the whole forming a wall impossible to carry fire from any inside connection. Over this a protecting jacket of cotton, fireproofed as above, is then braided, and finally coated with a slow-burning, flexible weather-proofing compound and dusted with a powder to prevent adhesion.

The interior of the conduit is the smooth, hard finish of the cotton duck, which is very easy to fish, but to make it perfect in this regard it is dusted with powdered soapstone, which acts as a lubricant, rendering the surface very smooth for the wire to pass by.



NEW PROCESS FIBER CONDUIT

Alphaduct conduit is manufactured by a patented, new and original process, especially designed to combine all the most highly approved and up-to-date ideas as to what is desirable and essential in a conduit of this class for electric wires, the makeup of "Alphaduct" being carefully restricted to approved substances so there may be no deterioration in the manufactured article.

This conduit is made by the Alphaduct Manufacturing Company, 522 West Twenty-second street, New York city.

The Combined Deflector and Guard for Electric Fans.

The Diehl Manufacturing Company, Elizabeth, N. J., has secured the right to manufacture the Coleman combined deflector and guard for the trade. This is a guarantee that it is a meritorious article and will meet the approval of those desiring a device that will distribute the air over a large area instead of in one direction. The Coleman deflector is simple in construction and can easily be attached to any make of fan. It will distribute the air through a maximum angle of 140 degrees, or nearly one-half of the circle, but when desirable the angle can be reduced by changing the pitman on the worm-wheel. It is positive in operation and will operate on any speed and any angle of inclination of the fan. The driving power is direct from the fan shaft by means of a small pulley placed between the fan blade and bearing; a suitable belt from this pulley to pulley on worm drives the gear-wheel, every revolution of which changes the angle of the deflector vanes. The body of the fan does not turn. It can be substituted on any make or style of desk or bracket fan for the old guard and is furnished complete with adjustable guard supports, shaft pulley and belt. A screw-driver is all that is necessary to make the substitution.

The desirable features of the device are simplicity in construction, attractive appearance, ease of installation, positiveness of operation at any angle or speed of the fan. The area over which the air is directed can be lessened by shortening the stroke of the pitman. This is done by moving the pitman screw to a hole nearer the centre of the gear-wheel.

The guard is made of two rings of square brass which are held securely by spokes that are shouldered on inside and riveted on outside of ring, thus making the guard very strong and rigid. The guard supports have slots one and one-quarter inches long in one end giving sufficient adjustment for attaching to any make of fan. On the upper side of the guard is attached the worm and gear bracket. The four vanes are connected by brass strip and driven by the pitman. When shipped from the factory the deflector is adjusted to give the maximum area over which the air can be distributed.

A New Ohmmeter.

The many inconveniences of the usual type of Wheatstone bridge for practical use have induced instrument makers to design apparatus which would overcome these defects, yet give accurate results. An excellent example of this was the Sage direct-reading ohmmeter, brought out a few years ago. This instrument soon became well known as one of the most satisfactory substitutes for the portable Wheatstone bridge.

Recently a new type of this ohmmeter was brought out which has a number of new features, adapting the instrument to measurements and testing of all kinds.

The Sage ohmmeter itself is a modified type of the slide-wire Wheatstone bridge. One arm of the bridge is a standard resistance coil. A second arm is, of course, the unknown resistance, and the place of the other two arms is taken by the slide wire. The batteries are connected to the ends of this wire, and the galvanometer circuit connected to the binding-post between the standard resistance coil and the unknown, and, by means of the slider, to any point on the slide wire, thus dividing this wire so as to form the other two arms of the bridge. By moving this slider along the slide wire until the point of balance is found, the ratio of the unknown resistance to the known is, of course, proportional to the ratio of the two arms of the slide wire, enabling the resistance to be read off directly in ohms. In the previous type of Sage ohmmeter, the galvanometer was replaced by a telephone receiver, and readings were made by tapping the slide wire with the slider at various points until no click was noticed in the telephone. This arrangement, as is well known, is very reliable and satisfactory. To give a good range for the meter, four standard resistance coils are provided, any one of which can be plugged in by inserting a ground tapered plug into a solid brass post, making a practically perfect connection. This gives but one contact plug to be taken care of in place of the twenty or thirty usual with this type of bridge. Each of the contact posts is marked by a certain color, and the corresponding scale of the instrument is printed in the same color, making an error due to reading from the wrong scale practically impossible. Two types of this ohmmeter are made—A, giving ranges of from 0 to 10, 100, 1,000 and 2,000,000 ohms, and type B, ranging from 0 to 10, 100, 1,000, and 200,000 ohms. In use, this instrument is very quick, enabling one to determine in a few seconds the unknown resistance within less than one per cent.

The new type of ohmmeter embodies all the essentials of the one just described, and in addition, has a sensitive galvanometer which can be cut into circuit in place of the telephone receiver, if desirable. The galvanometer, shown in the illustration, is mounted in the cover of the instrument, where it is always in position for use. It can be turned about its centre, enabling the needle to be set at zero no matter what the position of the instrument. In addition to the galvanometer a small induction coil is also mounted in the top of the box. By a suitable double-pole switch this can be cut in circuit so as to send an alternating current through the bridge in place of the battery current.

NEW TYPE OHMMETER.

With this coil in circuit the telephone can be used. A loud hum is heard, except when the point of balance is found on the slide wire. The slider can then be quickly moved over the wire until the proper position is found, and the resistance read off directly. The use of this induction coil enables the ohmmeter to be used for measuring inductances and capacities by the well-known methods. In these cases, of course, a standard inductance coil or condenser is connected in place of the usual coil contained in the ohmmeter. Binding-posts are provided for these connections, and when in use the usual plug is left out.

The switch for closing the battery circuit is contained within the telephone receiver, a suitable circuit being run to that point for this purpose. This switch can then be manipulated without removing the receiver from the ear. This type of ohmmeter is also suitable for measuring the resistance of electrolytes, but where this is the principal use to which the instrument is to be put a special form is constructed, which is a little better adapted to these measurements.

In practical use the Sage ohmmeter is very convenient for locating faults of electrical machinery and circuits, as it can be used wherever the inspector can work. Grounds on a line are found by disconnecting the standard resistance coil and grounding the centre post of the meter. The line is then connected to the other two posts and short-circuited at the far end. Moving the contact slider along the wire until a balance is obtained, the reading shows the percentage of the total length of line which the ground is from the instrument. By a similar arrangement a cross in a circuit is quickly located. Open circuits are located by comparing the capacities of the two sections of line.

The meter is also suitable for measuring the internal resistance of batteries or of any source of electromotive force.

The ohmmeter is handsomely mounted in a strong box, and is entirely self-contained. Connections to the galvanometer and coil are made through double hinges and solid copper straps, avoiding all difficulty with loose or broken connections. A good leather handle attached to one end makes the instrument very convenient to handle, and a card of instructions is furnished with each box.

These ohmmeters are manufactured by the well-known firm of instrument dealers, Machado & Roller, 203 Broadway, New York city.

A Method of Wiring in Connection with the Operation of Engine-Stops and Electric Motors.

The necessity and importance of stop mechanism for engines and motors are abundantly emphasized by the extended recognition given them by the manufacturers and property-owners.

Illustrated herewith is a system of wiring by F. S. Palmer, 100 Broadway, New York city.

Fig. 1 shows a slate board upon which is mounted a double-throw switch. A single-throw switch is also shown operated by electricity, a high-resistance bell, a small single-throw switch, and binding-posts 1, 2, 3, 4 and 5 shown in Fig. 2. The board is to be located at some desirable place in the building where the engine or motor is to be stopped from any section or floor by the use of circuit closers CC in Fig. 2. The double-throw switch is used to test all the wires and ring the high-resistance bell without operating the stop mechanism. The small switch is used to operate the motor switch or stop mechanism as often as desired, thus keeping them in active use.

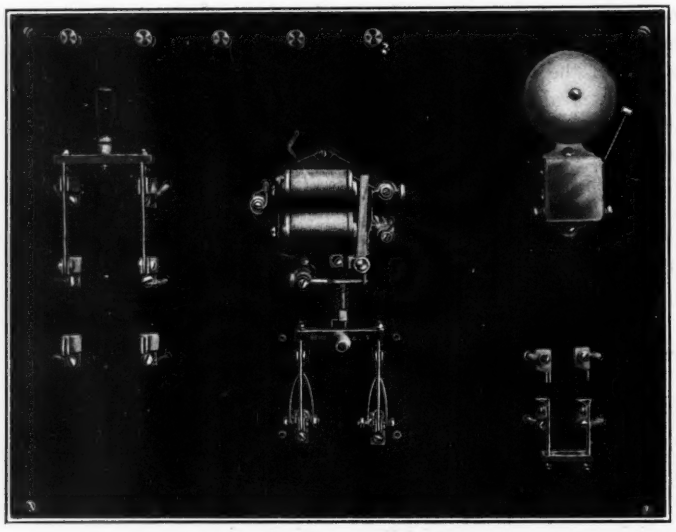


FIG. 1.—MOUNTING BOARD FOR ENGINE-STOP SYSTEM.

Fig. 2 is a detail drawing of the method of wiring any engine-stop mechanism, showing circuit-closers on three floors. To operate the engine stop or open the motor switch, the circuit-closer CC is used—say third floor. The current passes from battery to binding-post 5, engine-stop magnets or electric switch for motors to post 4, post A, on test switch to B, to post 3, circuit-closer CC, third floor, to post 2, to battery or from battery to post 5, to stop or switch, as above, to post 4, to circuit-closer CC to post 2, to battery. Thus it will be seen that should one or both wires connected to circuit-closer CC on third floor be cut the closer will remain operative.

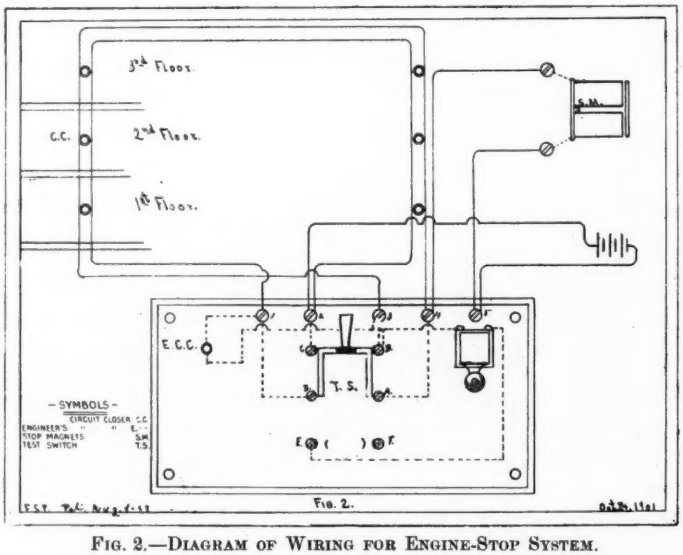


FIG. 2.—DIAGRAM OF WIRING FOR ENGINE-STOP SYSTEM.

To test wire and battery throw the test switch so that the blades rest in knives at E and F. The wires are then in series with magnets of stop or motor-switch blade, post D, post 1, section wire, post 2, to battery. The battery will fail to ring the bell several hours before there is not enough current to operate the stop or motor-switch magnets by the use of any circuit closer, while should there be any break in the wires the bell will fail to ring at test.

It will be seen that the operator in charge of this apparatus would be very negligent if he permitted it to get out of order. He can use the small switch for stopping either engine or motor every day if he chooses, thus assuring himself that everything is in readiness for stopping the same from any floor in the building. Arrangements can be easily made to notify outside parties of any shut down if desired.

This method of operating stop magnets is also arranged with annunciators to indicate the floor or section in which the circuit closer has been operated, also to make record of all tests.

Nail Puller for Electricians.

An article of practical value to electrical men is the small nail-puller illustrated in the accompanying engraving. This puller weighs two and one-half ounces and can be carried in the pocket for pulling small nails without the assistance of a claw-hammer. The electrician is aided in taking nails from strips covering insulating wires. The prices of these implements are low, and they are manufactured by the Smith & Hemenway Company, New York city.

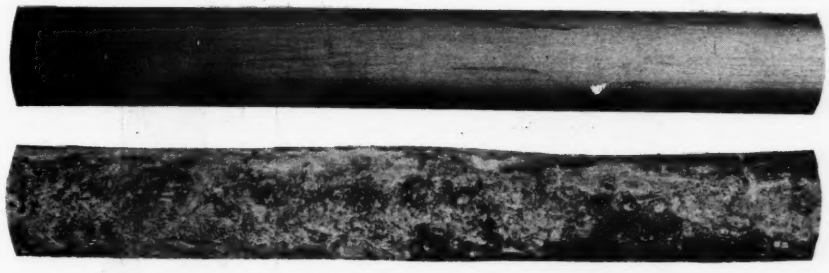
Annual Automobile Show.

The annual automobile show will open in Madison Square Garden on Saturday, January 17. There are 122 exhibits in all, of which fifty-six are devoted to the manufacture of automobiles, the remainder dealing with tires, lamps, wheels and other parts and accessories. It is expected that the volume and variety of the exhibits will show a striking growth in the automobile industry since the first exhibition held in the Garden in 1900. Not only will the exhibition be representative of American manufacturers, but there will also be a number of foreign exhibits. Typical forms of electric storage batteries and the latest appliances in electric vehicles will be on exhibition.

Bituminized Fiber Conduit.

The growing tendency of municipal authorities to compel the placing of transmission circuits of any capacity whatsoever underground has made the demand for conduit increasingly necessary, and the past six months has witnessed the placing of contracts for more duct feet of conduit than almost a score of prior years would total. The essential of a good conduit is, above all, its ability to withstand the electrolytic action of currents which may be present in the soil surrounding conduit lines. Again, it must have the ability to withstand the deleterious action of soil which is more or less impregnated with oxidizing agents, and in some cases where direct chemical reactions are a positive danger. Besides possessing these properties, which make for the long life of the conduit, it must be of such construction as to facilitate its rapid construction, and the problem of making joints and easy angles is one which has required the best ability of the conduit manufacturer to overcome.

Constructing a Pipe Line of Bituminized Fiber Conduit.

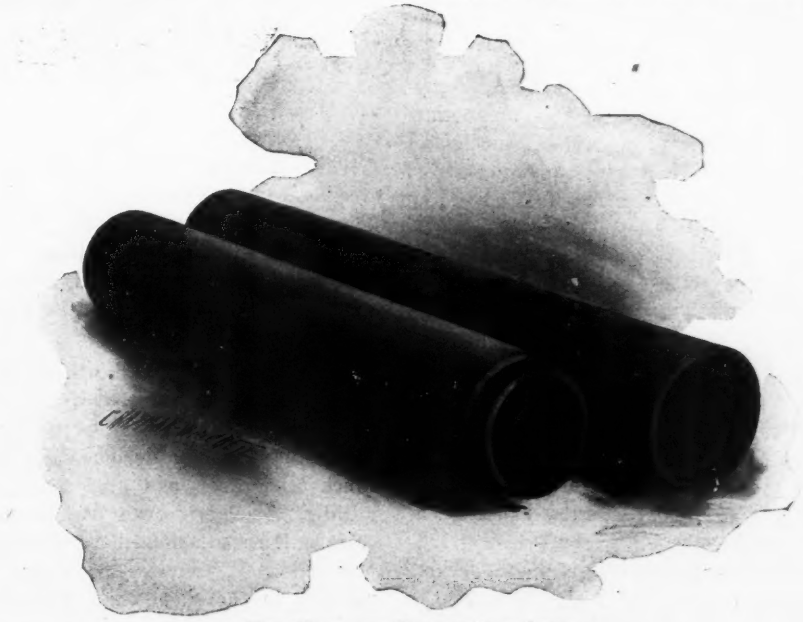


Result of a Test Made at Oakland, Cal.

The conduit shown in the accompanying engravings is made from a specially prepared bituminized fiber. This conduit has a number of points of merit which the electrical engineer and those interested in the construction of subways will readily recognize. The manufacturers' claims are essentially as follows:

The nature of the conduit makes it electrolysis proof, affording a thorough protection to the cable, as shown by the result of a test made upon a specimen of bituminized fiber conduit and a piece of vitrified clay conduit. This test was made at Oakland, Cal., during July, 1900, by the Sunset Telephone and Telegraph Company. The duration of the test was 524 hours, a section of each of the respective conduits being placed one after the other in a box having four inches space on all sides of the conduit filled with damp earth. A short length of lead cable was placed in the conduit to which was connected the positive wire, and then a layer of pulverized coke laid between the cable and the conduit for effective contact. A lead plate was placed in the bottom of the box to which the negative wire was attached. The voltage was 485 and the amperage 5.4 at the beginning, ending at 2.4, making an average amperage of 3.9. The resistance at the start was 89 ohms and at the finish 198 ohms. It is stated that under this test no electrolytic action was noticed in the bituminized fiber conduit. The report of this test was signed by C. O. Poole, superintendent of the Standard Electric Company of California; F. W. Alston, electrician of the Sunset Telephone and Telegraph Company, and L. D. Fitzgerald, superintendent electrical department, San Francisco Gas and Electric Company.

Another feature of importance is its high insulating quality, having withstood voltages from 50,000 to 66,000 volts without puncturing, its freedom from abrasive



The Male and Female Slip Joints.

action in drawing in and out the lead-covered cables. This feature, and also that of the male and female slip joint, which is turned true in a lathe and is a characteristic peculiar to this conduit, facilitate the rapid construction of conduit lines. This joint also makes alignment very simple and holds the conduit in a true line from manhole to manhole, and obviates the necessity of building up with cement or wrapping the joints with burlap or other coverings during construction.

The conduit is made in seven-foot lengths, this size being handled easily owing to the lightness of the material.

The conduit is non-brittle and tough in its nature, and can easily be cut with an ordinary saw, which simplifies the operation of cutting and fitting. The conduit is manufactured by the American Conduit Company, with offices and factories at Los Angeles, Cal., and Chicago, Ill. The company has just established a large and complete factory at Chester, Pa. These points of supply distributed in this manner give desirable shipping facilities, and conduit users can be accommodated with ease on contracts of almost any magnitude.

Foot-Power Lathes.

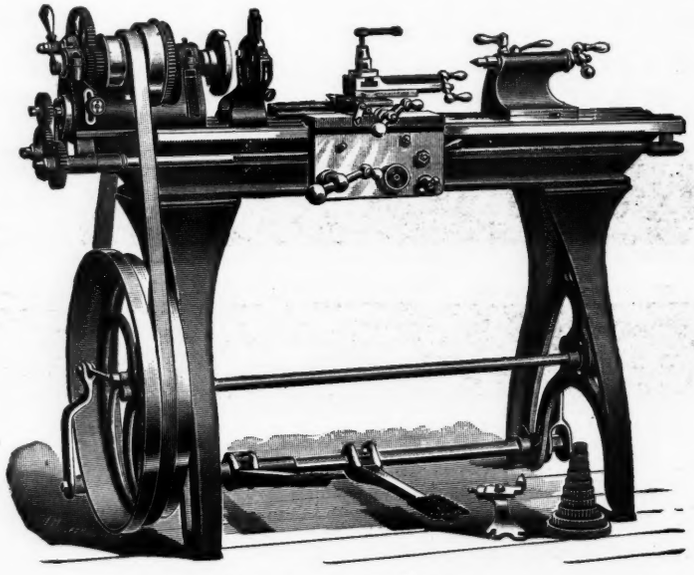
The "Star" foot and power lathes are well known as good samples of high-class tools. The accompanying illustration shows one of the latest types of "Star" foot lathes which is well adapted for repair shops, experimental and model work and all shops requiring durable and accurate service.

These lathes are made in varying sizes ranging from nine inches swing, twenty-four inches between centres, up to thirteen inches swing, sixty-six inches between centres, and are mounted on curved legs when furnished with foot power; on straight legs for shop use with countershaft, and on oil-pan for tool-room use.

The head-stock has a hollow spindle made from a crucible steel forging, running in long phosphor-bronze bearings with an improved end thrust ball-bearing. The tail stock is of improved curved pattern which allows compound rest to swing around parallel with the ways and over the base of tail stock with room to operate feed-screw handle. The tail-stock spindle is arranged with self-discharging centre and improved locking device, and adjustable side movement is provided for turning tapers.

The carriage has a long bearing on the ways and is gibbed to bed both front and rear. Interchangeable, plain and compound rests with graduated base for making fine adjustments. The improved tool post collar and shoe exclude all dirt and chips, and admit of a quick, easy and secure adjustment of the tool.

The automatic cross and longitudinal feeds are actuated by a phosphor-bronze worm on the lead screw which is splined, and for all work except screw-cutting it simply acts as a feed rod, and therefore the only wear on its threads is in screw-cutting. Graduated collar on cross feed screw for fine, accurate adjustment. The feed may be thrown in or out of contact by simply moving a lever, and will feed in or out, right or left, and cut screws right or left. All standard threads from three to sixty-four can be cut without compounding the gears, and nearly all threads by compounding them.



NEW FOOT-POWER LATHE.

The patent foot power consists of two treadles with a walking motion. It can be started or stopped instantly, and may be operated with both feet, sitting, or one foot, standing. When desired, a friction countershaft will be furnished in place of the foot power.

Each lathe is provided with a centre rest, follower rest, point centres, full set of change gears, necessary wrenches, etc.

Blocking, taper attachment, draw-in chuck attachment, and gear-cutting and milling attachment can be furnished extra. Each attachment is thoroughly practical and accurate and almost invaluable to the shop where a complete equipment of machine tools is not kept.

The "Star" lathes are made by the Seneca Falls Manufacturing Company, 420 Water street, Seneca Falls, N. Y.

Sir Hiram Maxim to Visit the United States.

The Manchester, England, *Chronicle* in a recent issue has the following to say concerning Sir Hiram Maxim:

In about a fortnight's time Sir Hiram Maxim will leave England for America, where he expects to remain about two years. Sir Hiram explained to a newspaper representative that he had a two-fold object in making a long stay in America. In the first place, he hopes to cure a troublesome throat complaint; and secondly, he intends to carry out an important series of experiments with a view to building a flying machine. Sir Hiram said:

"I have always thought that the state of Connecticut is a most excellent place for conducting flying-machine experiments, and there are also parts of Long Island which are admirably suited for the purpose, the land being low, free from roads, houses and trees, while the ground can be bought cheap, as it is practically worthless for agricultural purposes. It is not necessary for me to say that if one is to build a real flying machine many experiments will be necessary before one can hope to take free flight high in the air. One must learn to manœuvre the apparatus on or near the ground, and for this purpose it is absolutely necessary that a large and level field should be available. If I do not build a flying machine myself, it is quite possible that I may become the consulting engineer on the subject for the St. Louis Exhibition; but, of course, if I am a competitor myself I shall certainly refuse to take any official position.

"It appears to me that we are coming very near the area of successful flying machines. I think there are about 100 different persons experimenting at the present moment. The greater number of

these, however, are experimenting with balloons; but balloons, in the varying nature of things, can not succeed. To propel a balloon in the air at the velocity that the wind blows on 200 days in every year would tear it to pieces. On the other hand, flying machines must travel fast, otherwise the wings get no grip upon the air. Up to the present, except with small apparatus which may be considered as toys, no true flying machine has succeeded."

High-Potential Insulators.

With the necessity for increasing the distance of transmission in order that the power of water falls may be utilized at

FIG. 1.—HIGH-POTENTIAL INSULATOR.

points far removed from the prime base of power supply, the question of insulation becomes of the most serious importance. The installation projected by the Guanajuato Power and Electric Com-

FIG. 2.—HIGH-POTENTIAL INSULATOR.

pany, and also by the Washington Water, Light and Power Company, of Spokane, Wash., requires an insulator of a capacity that was considered only a short time ago beyond the possibility of handling.

In Fig. 1 is shown the type of porcelain insulator which will be used by the two above-named companies. This insulator is one of the highest voltage insulators in the world, and has a rated capacity of 60,000 to 80,000 volts, being tested at 125,000 volts. Weight, 15 pounds; diameter, 14 inches; height, 13 inches.

Fig. 2 is an all-glass, high-voltage insulator, furnished where a low-price, high-voltage insulator is desired. Tested at 120,000 volts; weight, 12 pounds; diameter, 11 inches; height, 11 inches.

These insulators are manufactured by the Locke Insulator Manufacturing Company, Victor, N. Y.

Enclosed Contacts.

The Crouse-Hinds Electric Company, Syracuse, N. Y., manufactures an extensive line of Norbitt specialties embracing many forms of porcelain electrical appliances. These are designed to meet the latest requirement of the National Board of Fire Underwriters regarding the elimination of exposed contacts. All the current-carrying parts of the Norbitt specialties are designed for much heavier work than the type of apparatus calls for, and

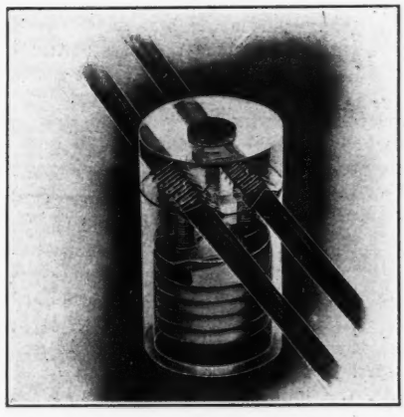


FIG. 1.—TEMPORARY SOCKET FOR DECORATIVE PURPOSES.

the mechanical details are carefully worked out and treated in a liberal manner. All screw shells are made of the best lake copper.

Fig. 1 shows a temporary socket which is for use for decorative purposes with standard lamps and standard stranded wire. The electrical connection is made, as may be readily understood from the illustration, without removing or affecting the insulation of the wire. The socket can be easily and quickly installed either before or after the wires are in place and is strictly weather-proof. The adjustability of the appliance permits the use of any size conductor from No. 14 to No. 4. The electrical and mechanical construction is very substantial, and the socket is used on 250 volts in multiple or on 600 volts in series.

Fig. 2 shows a permanent moulding receptacle, embodying the enclosed contact. The receptacle is made in two pieces, cap and base. The base is fastened permanently to the moulding with one screw through the centre. The initial electrical connection to socket wires is easily and securely made by means of two binding screws on the top surface of the base, thus avoiding the inconvenience of binding screws on the sides of the base.

The cap is permanently secured to the base by two screws which serve the double purpose of fastening the cap in place and completing the electrical connection. The two screws are so constructed as to prevent their falling out during installation,

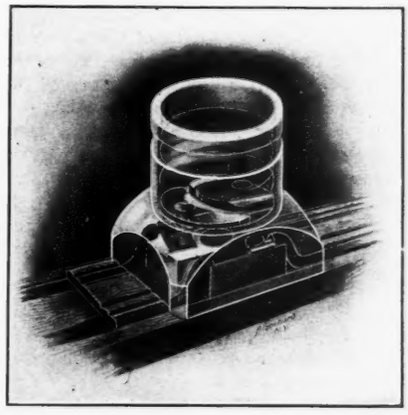
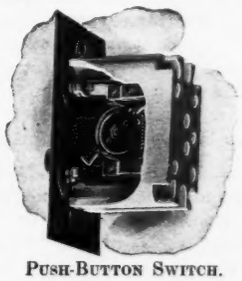


FIG. 2.—PERMANENT MOULDING RECEPTACLE.

which will be greatly appreciated by wiremen in overhead work. The base is permanently installed while the rough work is being done, and can not be affected by plasterers, decorators and other workmen.

Push-Button Switch.

The push-button switch illustrated in the accompanying engraving is possessed of a number of distinct features. The switch mechanism is entirely encased in one piece of strong porcelain. The face plate is a patented, hydraulic forging, made to the standard of the National Electrical Contractors' Association, two and one-half inches by four and one-quarter inches. This plate admits of a very high finish, and is rigid and true in all of its dimensions. The switch mechanism is of fine construction, all of its parts being machined, making the action remarkably easy and certain. Flexible



PUSH-BUTTON SWITCH.

tungsten steel springs permit the combination of a strong and quick break at the contacts, with an easy and flexible push of the buttons. The switch has ample room for drawing in and connecting wires, and will fit any style of conduit box. This switch is manufactured by the Marshall-Sanders Company, Boston, Mass.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW SOUTH WALES TRAMWAY—It is stated that a contract for electrical equipment for the tramway system of the New South Wales Corporation, aggregating over $2,000,000, will be placed with an American manufacturer.

THE WHITE HOUSE ELECTRIC LIGHT SYSTEM—The new electric lighting system of the White House at Washington, D. C., was given a thorough test at the recent New Year's reception. The brilliant interior lighting was one of the features which occasioned a great deal of favorable comment. The electric lighting plant is one of the most modern and complete ever installed, three distinct systems being run by the outfit. There are 3,000 electric lights, and power is also used for ventilating fans and elevators, automatic electric pumps, and an electric bell system, including telephones to all the rooms. There are thirty-one miles of wire laid down, and the plant cost $95,000. The lighting effects are simple in design, but of great attractiveness.

THE POWER PLANT AT THE LOWER FALLS, ROCHESTER, N. Y.—Considerable progress has been made at the power plant of the Rochester Gas and Electric Company at the Lower Falls of the Genessee River, Rochester, N. Y. The company has already installed three 6-foot penstocks, driving about thirty-five dynamos for arc lighting. The new station being constructed under the direction of George Redman, the superintendent of the company, is about 100 feet long, the new part being forty-seven feet wide. The foundations are sunk into solid rock in the bed of the lower river, and built up on solid concrete. The south wall of the station is formed by a solid rock of the precipice. The difference in water level is 103 feet 6 inches, giving a powerful available head. The two immense penstocks are bent over the brink of the precipice inside the station building. The penstocks are eleven feet in diameter. One is completed and the other is in process of completion. Three twin turbine wheels of 2,100 horse-power capacity are to be placed above each of these penstocks, receiving the water from below.

RUSH-HOUR SERVICE ALL DAY ON MANHATTAN ELEVATED—As a result of the recent agitation growing out of the over-crowding of the cars on the operating systems of the Manhattan Elevated Railway Company, the State Railroad Commission of New York has issued drastic recommendations. Summarized, the conditions are essentially as follows: The trains now used in the rush-hours are to be operated from the beginning of the morning rush-hour until midnight. Three-hundred additional cars are to be added to this service by April 1, next. The company is to begin the construction of third tracks on the Third avenue line from Ninth to Fifty-ninth street; on the Second avenue line from Canal to 129th street, and on the Ninth avenue line from Fourteenth to Cortlandt street. The Manhattan Railway Company has not agreed to make the changes demanded. It is expected that one or more of the reforms demanded by the Railroad Commission will be opposed, and it is expected that the demands of the State Board will be made an issue before the proper courts. The adding of 100 extra cars a month for the next few months is favored, as is also the building of the third tracks.

TO EXTEND THE OSWEGO LINE—It has been announced in Syracuse that the electric railway which is being promoted by rapid transit men, to connect the Liverpool extension of the rapid transit system and the Oswego Traction Company's system, which was recently acquired by the trapid transit company, will be built according to one of two plans. The Oswego Traction Company will increase its capital stock from $300,000 to $1,200,000, or the property of the Oswego Traction Company will be transferred to a new corporation of $1,200,000 capital, to be called the Syracuse, Fulton & Oswego Railway Company. It is proposed to build on the east side of the river from Liverpool to Fulton, to cross the river there, and to connect with the Oswego city system on the west side of the river, going through Fulton and Minetto. The new owners of the Oswego system are contemplating extensive improvements for the local service of that city. The capital of the Oswego company is now $300,000, and its annual earnings have been $40,000. Considerable money will be spent in new construction and equipment for the purpose of increasing patronage so that the annual earnings may be increased to $60,000.

NEW YORK CENTRAL TERMINAL PLAN—It is announced that Mayor Low and his associates in the board of estimate have approved plans for improving the New York Central terminal facilities in New York city. The principal features of this are the abandonment of the use of steam as a motive power in the tunnel; the depression of the tracks so as to make practically grade thoroughfares of the eleven streets intercepting the steam tracks between Forty-fifth and fifty-fifth streets; the continuation of Park avenue as a single street southward on a viaduct from Forty-ninth street, where it now ends, to Forty-fifth street, the boundary of the station; the payment by the Central Railroad Company of $25,000 a year for extra sub-surface privileges; the payment by the city to the company of $600,000 for constructing new grade bridge across Park avenue. The railroad company's request for vault privileges under Lexington avenue has been refused because of the city's desire to build an east-side extension of the subway under that avenue. The recommendation also includes a plan for a connection under Forty-second street with the new subway system. The total cost of all the changes involved is estimated at about $25,000,000.

ELECTRIC LIGHTING.

NARRAGANSETT, R. I.—The council has granted an exclusive franchise for twenty-five years to the South County Gas and Power Company.

PHILLIPSBURG, PA.—The People's Electric Light and Power Company of Easton has been granted permission to extend its lines into this town.

ALGOMA, WIS.—At a special election, held recently, it was voted to erect a lighting plant. Work on the plant will begin as soon as possible.

HARTFORD, CT.—The Branford Lighting and Water Company has filed a petition with the Secretary of State for authority to increase its capital stock to the amount of $500,000.

UNIONTOWN, PA.—Negotiations were recently closed whereby the Dawson electric light and power plant passed into the possession of the Pittsburg, McKeesport & Connellsville Street Railway Company. The purchase price was $25,000.

CONCORD, N. H.—The Connecticut River Power Company has been incorporated by Brattleboro men, with an authorized capital of $200,000, which may be increased to any sum not exceeding $1,000,000. The legislature of New Hampshire will be asked for a similar charter. The company will push the project for a dam across the Connecticut River a short distance below the railroad yard in Brattleboro. It is expected to develop here one of the greatest water powers in New England.

JELLICO, TENN.—A company known as the Jellico Electric Light, Heat and Power Company, with an authorized capital of $12,000, has been granted a charter. The company purposes to establish an electrical energy plant, by means of which sufficient power will be developed to light the city by an improved system, and at the same time furnish lights for mine use and provide power for the use of mills of various kinds. The men interested in the company are as follows: R. B. Baird, W. S. Harkness, W. T. McGuire, S. W. McComb and M. J. Steinberg.

KALAMAZOO, MICH.—The new Plainwell dam of the Kalamazoo Valley Electrical Company has been put in operation, giving the company an additional 1,600 horse-power. The new dam is 700 feet long and the power-house is of the most modern construction. The cost of the work has been in the neighborhood of $150,000. As soon as the weather will permit, work will be begun on another dam across the Kalamazoo River at Pine Creek, about six miles below the Plainwell dam. Over 2,500 horse-power can be gained from this location, and the company expects to have the dam in operation by next summer.

PERSONAL MENTION.

WALTER C. FISH, of the General Electric Company, Lynn, Mass., has been elected a director in the Fore River Ship and Engine Company.

MR. J. N. PRATT, treasurer and general manager of the Jarvis Engineering Company, Boston, Mass., was a caller at the office of the ELECTRICAL REVIEW last week.

MANNING K. EYRE has been elected president of the Buckeye Electric Company, Cleveland, Ohio, to which position he has advanced from that of general manager of sales of the company.

MR. CHARLES CUTTRISS, chief electrician of the Commercial Cable Company, returned last week from San Francisco where he had been for several weeks looking after the practical interests of his company in connecting up the new Pacific cable.

MR. H. G. MADDEN has become a member of the staff of Mr. W. R. Brixey, owner and manufacturer of Kerite wires and cables. Mr. Madden, who is an experienced insulated wire man, will be the agent of the company, with headquarters at 203 Broadway, New York.

MR. CHARLES BLIZARD, Philadelphia, general sales manager of the Electric Storage Battery Company, was a visitor in New York city this week. Mr. Blizard has just returned from a highly successful trip throughout the west, and finds the demand for storage batteries increasing in all directions.

MR. F. C. PHILLIPS, president of the Elwell-Parker Electric Company, Cleveland, is an enthusiastic electromobilist and uses one constantly in his daily trips around the city and between his home and his office. Mr. Phillips's company manufactures one of the most successful motors for this work, and he of course uses one in his own machines.

MR. CARL HERING, the well-known consulting engineer, of Philadelphia, has reprinted his paper before the Niagara Falls meeting of the American Electrochemical Society upon "An Electrochemical Paradox." This is a description of an exceedingly interesting experiment, in which apparently Faraday's law was not followed. This phenomenon, however, was explained satisfactorily.

MR. J. F. BLAUVELT, Providence, R. I., of the New England Butt Company, was in New York this week. Mr. Blauvelt's company is one of the oldest houses engaged in the manufacture of machinery for insulating electrical wires. Its braiders are known wherever electrical wires are insulated, and Mr. Blauvelt reports a constant increase in this department of the company's business.

MR. EDWIN R. WEEKS, consulting engineer, of the firm of Weeks, Kendall & Newkirk of Kansas City, Mo.; Professor J. W. Kent, at the head of the electrical department of the Manual Training High School of Kansas City, and Mr. G. C. Roe, E. E., of Havana, Cuba, who engineered the United States Government "Electrozone" plant at Cuba, for the sanitation of the city, were visitors in New York during the past week and honored the editorial offices of the ELECTRICAL REVIEW.

MR. WILLIAM MARCONI was given a dinner on the evening of December 30 by the citizens of Sydney, Nova Scotia. The tables were brilliantly decorated, electrical effects being improvised to illustrate wireless telegraphy. The guests included George H. Murray, Premier of Nova Scotia, and many prominent members of the Canadian parliament, the mayors of Cape Breton and Mr. Marconi's staff. Mayor Crowe of Sydney proposed a toast to Mr Marconi which was received with enthusiasm, and he made a brief reply.

MR. DAVID BELASCO, the eminent playwright and theatrical manager, is to be complimented on his intelligent and highly successful use of the electric light in creating interesting effects at his theatre in New York. The various beautiful applications of the electric light in the presentation of the "Darling of the Gods" are at once unique and thrilling and show Mr. Belasco to be not only a great theatrical manager but as one possessed of a fine understanding of the possibilities of the safest and most flexible of all illuminants.

MR. BION J. ARNOLD, the eminent consulting engineer of Chicago, has completed his report on the Chicago transportation problem. Mr. Arnold was retained by the city of Chicago in July of last year to make a complete study of the engineering and operating features of the transportation problem of that city, and this report gives the results of his most thorough study and the plans suggested for providing the city of Chicago with an efficient transportation system. The report contains 310 pages, and is fully illustrated with plans and diagrams, and is accompanied by a portfolio of charts and maps. This is undoubtedly the most complete report of the transportation system of a large city ever made. It will be abstracted in our issue of next week.

MR. GEORGE WESTINGHOUSE—A recent special London cable despatch to the New York *Daily World*, says: "George Westinghouse is here now taking things easy at his hotel for the holidays after two months of hard work. There is no busier man in London than this great engineer. At seven o'clock in the morning he is out to his city office—three hours before the leisurely English capitalists think of starting to work—and often before that hour he is speeding to Manchester to see to his enormous establishment there, which is quite as large and important as his Pittsburg house. Mr. Westinghouse takes no recreation in London. He hardly ever goes to the theatre, and no one has ever seen him at a race meeting. His work is his life. Every railway train in the United Kingdom is fitted now with his air brake. He will return to Pittsburg early in February."

ON THE EVENING OF DECEMBER 12, the Stromberg-Carlson Company gave a banquet at the Great Northern Hotel, Chicago, at which the following gentlemen were present: Messrs. Alfred Stromberg, T. R. Finucane, C. W. Stiger, A. J. Rousseau, H. G. Webster, A. Hulbrich, Eugene L. Brown, F. L. Martin, William Bowen, F. L. Middleton, R. B. Tyler, E. C. Lewis, H. B. Hewitt, H. D. Eddy, L. R. Krum, C. E. Knickerbocker, A. S. Munsell, G. A. Muir, Paul D. Meyers, G. H. Pierce, B. B. Willis, H. L. Du Pont, G. L. Burlingame and C. H. Hague. The banquet was given largely to enable the men to meet each other, also to explain to the salesmen the use of a new book of standard switchboard specifications, which the company has recently gotten out. This has been pronounced by many prominent telephone men, who have seen the book, as one of the most complete treatises on telephone switchboards that they have seen. Following the banquet and preceding the explanation of the above book, Mr. Bowen, the company's Iowa representative, in behalf of the salesmen presented Messrs. Stiger and Middleton each with a scarf pin with diamond setting. Following the presentation, Messrs. Stiger and Middleton responded in a fitting manner, thanking the gentlemen for the token of their appreciation, also for the efficient service rendered. Following this, remarks were made by Messrs. Finucane, Stromberg, Middleton, Bowen, Brown, Rousseau, Stiger, Martin, Tyler, Meyers, Lewis, Smith, Munsell and Pierce.

PROFESSOR J. J. THOMSON.

JOSEPH JOHN THOMSON, D. SC., F. R. S., 1889, for the last eighteen years Cavendish Professor of Experimental Physics at Cambridge University, England, was appointed Monday, January 5, by the Trustees of Columbia University to become head of the department of physics, to succeed the late Ogden Nicholas Rood. Professor Thomson was born at Manchester in 1856, and attended Owens College and Trinity College, Cambridge. At Cambridge he was Second Wrangler and Second Smith's Prizeman in 1880, Fellow of Trinity College in 1881, Lecturer in 1883, and President of the Cambridge Philosophical Society in 1894. In 1896 he was elected President of Section A of the British Association and is a member of the Athenæum and Saville clubs. Professor Thomson has contributed such a vast amount of literature on scientific subjects, particularly physics, that it is hard to say wherein his chief greatness lies. His most recent researches on the theory of ions have cleared away much of the mystery attendant upon the study of physical chemistry, and Columbia University is to be congratulated on thus securing so illustrious a chief for its department of physics.

ELECTRIC RAILWAYS.

ROANOKE, VA.—It is rumored that the Roanoke Electric Railway, Light and Power Company has been sold to a party of Philadelphia capitalists.

FARGO, N. DAK.—The city council has granted franchises to the Fargo & Moorehead Street Railway Company, which has estab-

lished headquarters in this city. The system will be in operation by July 1. The company is capitalized at $250,000.

BETHLEHEM, PA.—Local capitalists have secured the right of way for a new trolley line, tapping the slate regions at Bath, and running direct through the Bethlehems to Centre Valley, there connecting with the Philadelphia & Lehigh Traction Company's lines to Philadelphia. The new route shortens the distance fifteen miles.

MENASHA, WIS.—It is understood that Henry and Thomas Higgins will extend their street-car lines which are now in operation between Two Rivers and Manitowoc up through Door County to Sturgeon Bay. The proposed plan is to extend the line next year to Michicott, a village about twelve miles northwest of Two Rivers.

COLUMBUS, OHIO—The Toledo, Port Clinton & Lakeside Railway Company has been incorporated with a capital stock of $10,000 by Herman R. Klauser, P. McCrary, L. E. Flory, H. S. Landis and Daniel H. James. The company will build an electric road from Toledo to Lakeside, *via* Port Clinton, through the counties of Lucas, Wood and Ottawa.

YOUNGSTOWN, OHIO—The Youngstown & Southern Railroad Company has been granted a franchise by the council of East Liverpool, thus providing for the terminus of the electric road which is to open the southern territory for this city. The terms of the franchise require the company to give bond in the sum of $5,000 to guarantee starting operation by July 1, 1903.

CARLISLE, PA.—Joseph S. Shapley, representing a number of capitalists of this place, has been going over a proposed route for a trolley road from York to Gettysburg. It is learned that the proposed line will start at York, extend to East Berlin, thence to Abbottstown, to Hampton, to York Springs, to Dillsburg, a distance of thirty-two miles. From Abbottstown the line is to be continued by the way of New Oxford.

AKRON, OHIO—At the annual meeting of the Northern Ohio Traction Company held recently, plans for the reorganization of the company were adopted. The new company will be known as the Northern Ohio Railway and Light Company. The capital stock of the company was increased to $7,500,000, all common, there being no preferred stock. All the old officers and members of the board of directors were reelected.

ALBANY, N. Y.—A joint agreement, filed with the Secretary of State recently, certifies the consolidation of the Fonda, Johnstown & Gloversville Railroad Company, the Amsterdam Street Railroad Company and the Gayadutta Electric Railroad Company under the name of the Fonda, Johnstown & Gloversville Railroad Company. The consent of the railroad commissioners to the consolidation is filed with the certificate.

INDIANAPOLIS, IND.—The Indiana Southern Electric Railway Company, of Aurora, has filed articles of incorporation with a capital stock of $10,000. The directors and incorporators are: Ernest W. Swarthout, Cassius W. McMullen, August Hermann, Randell J. Wymond and William V. Webber. Its purpose is to operate a street railroad in Aurora and an interurban railroad between Aurora and Rising Sun, and to furnish electric light and power to those cities.

CHICAGO, ILL.—W. T. Arthur, president of the Chicago, Waukegan & Elgin Railway, states that his company will build into Kenosha. The new line will be an outer belt system, joining all the roads centering in Chicago. It has secured all its franchises except that for the northern terminal. The line will extend from Kenosha on the north to Elgin, Ill., on the west, and to Hammond, Ind., on the south. The Kenosha line is planned as an extension from Fox Lake, Ill.

BROCTON, N. Y.—Surveys have been finished for the new electric road from Jamestown to Mayville. The work of securing formal rights of way will be taken up at once, and the company hopes to have the road finished and in operation next year. The road will skirt the southern shore of Chautauqua Lake, and will pass through Lakewood, Ashville, Stowe, Victoria, Steadman, and thence to Mayville. There is also talk of extending the line to Westfield in the near future, to connect with the new trolley line being built from Erie to Buffalo.

NEW INCORPORATIONS.

TROY, N. Y.—The Forest Park Railway Company. $20,000.

WHEELING, W. VA.—The Bellaire Electrical Company. $20,000.

DOVER, DEL.—The American Public Utilities Company. $2,000,000.

PHILADELPHIA, PA.—The Philadelphia Electric Company. $100,000.

MEMPHIS, TENN.—Natchez & Southern Railway Company. $5,000,000.

WATERVILLE, ME.—Clinton Electric Light and Power Company. $10,000.

WILMINGTON, DEL.—The Momand Street Lighting Company. Increased from $100,000 to $1,000,000.

TERRELL, MO.—Terrell Electric Light Company. $25,000. Incorporators: S. E. Noble, M. M. Raley and M. A. Joy.

FRANKLINVILLE, N. Y.—Empire Electric Company. $2,500. Directors: G. W. G. Ferris, G. E. Spring and R. O. Williams.

SEATTLE, WASH.—West Seattle Electric Company. $100,000. Incorporators: R. W. Bender, O. M. Spear and Fred E. Sander.

MADISON, WIS.—Eastern Wisconsin Traction Company. $50,000. Incorporators: D. M. Maxey, C. D. Cleveland, Jr., and W. F. Paul.

JERSEY CITY, N. J.—Kimmey Electric Light Display Company. $1,000,000. Incorporators: John Kimmey, Ives Horton, Charles A. Stader.

JERSEY CITY, N. J.—Halsey Electric Generator Company. $100,000. Incorporators: Henry Halsey, William S. Halsey and Howard H. Williams.

CLAREMONT, CAL.—Citizens' Light and Water Company. $75,000. Directors: L. T. Gillet, G. A. Gates, C. C. Johnson, E. C. Norton and L. N. Smith.

SAN FRANCISCO, CAL.—United Pacific Power Company. $100,000. Directors: E. J. Martin, P. J. Miller, H. L. Atkinson, W. S. Burnett and A. H. Winn.

AUGUSTA, ME.—The John A. Hamblin Company. $50,000. Directors: John A. Hamblin, Providence, R. I.; Joseph Williamson, Lewis A. Burleigh, Augusta.

NEWARK, N. J.—Montgomery Light and Water Power Company. $2,000,000. Incorporators: Charles N. King, W. Mondo Greene and Samuel E. Renner.

COLUMBUS, OHIO—The Columbian Central Electric Railway. $10,000. Incorporator : E. J. Miller, D. J. Ryan, Harry R. Young, E. C. Hecox and David H. Pigg.

NEW YORK, N. Y.—The American Electrical Specialties Company. $50,000. Directors: James Jones, James Jones, Jr., and Julius Silverman, of New York city.

VIRGINIA, MICH.—The Mesaba Light and Power Company, $25,000. Incorporators: John Castigan, Jr., and John D. Lamont, of Virginia, and Daniel D. Crowley, of Duluth.

NEW YORK, N. Y.—W. R. Ostrander & Company. $150,000. Directors: J. W. Purdy, Jr., W. H. Roberts, C. P. Lashell and I. A. Terrill, of New York, and H. E. Monk, of Flushing, L. I.

DENTON, MD.—The Citizens' Light and Fuel Company. $20,000. Incorporators: William H. Deweese, Albert G. Towers, J. Kemp Stevens, Harvey L. Cooper and Fred R. Owens.

INDIANAPOLIS, IND.—The Hercules Electric and Manufacturing Company. $10,000. Directors: John A. Kurtz, Albert S. Blackledge, John W. Blackledge, Stewart Kurtz and Frank H. Blackledge.

GUTHRIE, OKLA.—Central Oklahoma Union Depot and terminal Railroad Company. $5,000,000. Incorporators: W. S. McCall, J. C. Trimble, George T. Riehl, L. Underhood, J. J. Collister and W. H. Hottie, of Kansas City, Mo.; J. C. Robb, of Kingfisher, and George M. Thompson and L. M. Thompson, of Oklahoma City.

ELECTRICAL SECURITIES.

During the past week the market for securities experienced a decided upward tendency and a generally good rally in prices was recorded. It is now expected in financial interests that a period of good conditions is at hand and that this will last for some time. One of the most significant developments of the past week has been the renewed interest which the public has taken in the stock market, and this is looked upon as giving the upward movement a decidedly successful endorsement. The monetary condition was not very much relieved, but the prevailing opinion is that prices will gradually drift down to a normal level, and a steady improvement is consequently looked for.

The increasing volume of exports, notably in grain and cotton, will make the payment of foreign indebtedness possible with greater ease, and will exact a less extensive handling of direct payments. The most recent statistics show a condition of continued prosperity in almost every branch of manufacturing industries, and railroad earnings continue to show a large volume of freight moving and to be moved.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 3.

New York:	*Closing.*
Brooklyn Rapid Transit	66½
Consolidated Gas	217½
General Electric	184½
Kings County Electric	211
Manhattan Elevated	149
Metropolitan Street Railway	141
New York & New Jersey Telephone	162
Westinghouse Manufacturing Company	212

Boston:	*Closing.*
American Telephone and Telegraph	162¼
Edison Electric Illuminating	265
Massachusetts Electric preferred	94½
New England Telephone	137½
Western Telephone & Telegraph preferred.	99

Philadelphia:	*Closing.*
Electric Company of America	9 11/16
Electric Storage Battery common	76
Electric Storage Battery preferred	78
Philadelphia Electric	8⅛
Union Traction	46½
United Gas Improvement	110

The gross earnings of the Philadelphia Rapid Transit Company for the first twenty days of December increased $80,000 over those for the corresponding period of 1901.

Chicago:	*Closing.*
Chicago Edison Light	175
Chicago Telephone	160
Metropolitan Elevated preferred	87
National Carbon common	26
National Carbon preferred	97
Union Traction common	14½
Union Traction preferred	45

South Side Elevated showed a daily average of passengers carried during December of 88,513, being an increase of 8,774 over December, 1901. For the year the total amounts to 28,676,569, an increase of 2,356,380.

Metropolitan Elevated for December had daily averages of 115,682 passengers, an increase of 14,912.

AUTOMOBILE NOTE.

BILL FOR FEDERAL GOOD ROADS—The Hon. W. P. Brownlow, of Tennessee, has introduced in the House of Representatives a bill appropriating $20,000,000 by the Federal Government for building good roads throughout the United States. This has been referred to the Committee on Agriculture, and ordered to be printed. The course of this bill will be closely watched by a vast number of interests which are looking forward to Federal assistance in the creation and preservation of good roads.

INDUSTRIAL ITEMS.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., will probably add several exclusive specialties to its line during the coming year.

RABER & WATSON, Old Colony Building, Chicago, Ill., dealers in cedar telephone poles, have presented a number of friends with a handsome perpetual calendar.

G. M. GEST, New York city, has been awarded an additional contract in Dayton, Ohio, by the Oakwood Street Railway Company and the People's Street Railway Company for the reconstruction of their tracks in that city.

THE OKONITE COMPANY, LIMITED, New York city, manufacturer of insulated wires and cables, is receiving many congratulations for the successful manner in which it has carried out its work on the new trans-Pacific cable.

HUGO REISENGER, 11 Broadway, New York city, importer of the "Electra" flame light carbons, reports a very busy season. These carbons are suitable for all types of enclosed long-burning arc lamps, either direct or alternating-current.

THE WHEELER REFLECTOR COMPANY, Boston, Mass., reports a steady demand for the "Wheeler" street fixture. This is made with a porcelain and enamel reflector, and is equipped with the mica insulated joint peculiar to the reflectors made by this company.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., makes an alternating-current motor for sewing machines. The method of attachment leaves the table unobstructed and gives a perfect control of speed. Bulletin No. 3008 gives all particulars.

THE D. M. STEWARD MANUFACTURING COMPANY, New York city, has moved its office from 107 Chambers street to 8 Jay street. The company will continue the manufacture of its specialties and reports a continually increasing demand for "Lavite" and lava electric insulators.

THE RENIM SPECIALTY COMPANY, 176 Federal street, Boston, Mass., is the patentee and manufacturer of a number of electrical specialties which have a wide use in the trade. These are switch boxes, combination switch boxes, outlet boxes, wiring tubes, gang boxes and dining-room or annunciator bell attachments.

THE THRESHER ELECTRIC COMPANY, Dayton, Ohio, has secured a number of important orders for the "Thresher" multipolar engine-type generator. This company manufactures complete equipments for electric light, railway and power transmissions. The New York office is at 120 Liberty street.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, Mass., is manufacturing a complete line of electrical devices and specialties for residence, store, hotel, steamship, factory and general use. The company has recently adopted several new specialties, which will be accurately described upon application.

THE REYNOLDS ELECTRIC FLASHER MANUFACTURING COMPANY, formerly The Reynolds Electric Company, of 221 Fifth avenue, Chicago, Ill., has increased its capital stock from $2,500 to $15,000. This company manufactures automatic apparatus for manipulating signs and electrical displays.

JOSEPH P. MENCHEN, New York city, manufacturer of high-grade vulcabeston attachment plugs, is placing a number of orders for this apparatus. These plugs are especially suited for making quick connections in theatrical work and for trailer couplings and electric vehicle connections. The plugs are made in capacities up to fifty amperes.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY, Yonkers, N. Y., manufacturer of "Habirshaw" wires and cables, has secured several large contracts for wiring and construction. The Chicago Edison Company has recently wired the large buildings of the Marshall Field Company in Chicago, using exclusively "Habirshaw" weatherproof wire.

ELWELL-PARKER ELECTRIC COMPANY OF AMERICA, Cleveland, Ohio, describes in bulletin No. 100, its new "Class C" direct-current stationary motors and generators. These are built for

slow-speed work ranging in sizes from 3½ to 25 horse-power and 2¾ to 18¾-kilowatt capacity, for medium speed work in sizes from 5 to 30 horse-power and 3¾ to 22½-kilowatt capacity.

THE SHELBY ELECTRIC COMPANY, Shelby Ohio, has recently opened a new department in connection with its factory, for the manufacture of standard and miniature arc lamps. These are for both alternating and direct currents. The company will be pleased to send descriptive information to any one interested upon request.

THE PROCTOR-RAYMOND COMPANY, 444 Niagara street, Buffalo, N. Y., manufacturer of a complete line of electrical bells and knife switches, etc., will move on April 1 to new quarters at 40 to 44 East Larned street, Detroit, Mich. This is a new three-story building which will give the company greatly increased facilities for extending its already large line.

THE ALLIS-CHALMERS COMPANY, Chicago, Ill., illustrates in the tenth edition of its catalogue No. 5, rock and ore crushing plants. This shows a complete line of rock-crushing plants, elevating, screening, conveying and hoisting machinery. A great number of sectional drawings make the book valuable and interesting to mining, mechanical and electrical engineers.

THE INCANDESCENT ELECTRIC LIGHT MANIPULATOR COMPANY, Boston, Mass., makes a number of practical specialties for use with incandescent lamps. These are in the form of angle adjusters, lamp guards, combination shades, cord adjusters, combination cord and angle adjusters and lamp replacers and handy bulb cleaners. All of these materials have a wide use in the trade.

THE AMERICAN ELECTRICAL WORKS, Phillipsdale, R. I., manufacturer of bare and insulated electric wires and galvanized iron wire and strands, is distributing a calendar embellished with a miniature of Sir Humphry Davy. This is worthy of preservation not only because of its attractiveness, but because of the biographical sketch which is printed on the reverse side of the calendar panel.

THE C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., manufactures an electric storage battery locomotive, especially designed for use with industrial railways in machine shops, industrial establishments, smelting and refining plants, steel works, shipbuilding yards and numerous other applications. The company has issued some attractive literature describing these locomotives which it will be pleased to send to any one interested.

THE STANDARD TRACTION BRAKE COMPANY, 26 Cortlandt street, New York city, has changed its name to that of the Westinghouse Traction Brake Company. This company sells all power brakes for street railway service manufactured by the Westinghouse Air Brake Company, including straight or automatic air-operated brakes with axle-driven or motor-driven compressors, the storage system of air brakes, and the Westinghouse combined magnetic brake and electric car-heating apparatus.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, 183 Lake street, Chicago, Ill., general western agent for the Eureka flexible conduit manufactured by the Rittenhouse-Miller Company, Philadelphia, Pa., reports a very flattering reception of this conduit in the west. The larger construction people praise it highly and state that it is easily handled, reduces labor very considerably and makes a perfect insulation. The Eureka conduit has been in the west but three months and the Metropolitan company has secured a rapidly increasing business for it.

THE LUNKENHEIMER COMPANY, Cincinnati, Ohio, is the sole maker and patentee of the Lunkenheimer "Champion" rod-oil cup. This is suitable for all movable bearings, is simple and practical in construction, and can be filled without detaching the plug. A good feature is the glass sides which show the condition and the quantity of oil in use. The cup is attached so that the glass sides are parallel with the rod. When the cup is in motion, the oil begins to travel in a body within the cup and at each revolution is thrown against the feed tube and flows down through it to the bearing.

THE KINSMAN ELECTRIC AND RAILWAY SUPPLY COMPANY, New York city, is manufacturing a heavily insulated conductor for high-tension, spark-coil service for automobiles. This is composed of a number of strands of fine wire forming a core, immediately enclosed by a fibre covering, over which is applied an insulating substance. This is then enclosed in a thin rubber coating and thoroughly protected from either electrical or mechanical injury by a thick india-rubber sheathing, which in turn is covered by a closely-woven protective braiding.

THE BROWNING MANUFACTURING COMPANY, Milwaukee, Wis., maker of the celebrated Browning motors and dynamos, has arranged with the D'Olier Engineering Company, of Philadelphia, New York and Baltimore, to represent it in the east; the Western Electrical Supply Company in the southwest and the foreign department will be represented by the Goadey-McLean Company, 88 Maiden Lane, New York city. This is the result of a change contemplated for some time by the Browning company, and has been made necessary by the rapidly expanding domestic and foreign business.

THE MICHIGAN CENTRAL'S BULLETIN, descriptive of the Niagara Falls route and connecting lines to the winter resorts of Colorado, Arizona and California, is very attractive from an artistic as well as a practical point of view. The data embracing the railroad information proper is very complete and easily followed and the booklet is embellished with half-tone views of typical Mexican, Arizonian and Californian scenery. O. W. Ruggles is the general passenger and ticket agent, with headquarters at Chicago, and William H. Underwood is the general eastern passenger agent, 299 Main street, Buffalo.

THE AMERICAN SCHOOL OF CORRESPONDENCE AT ARMOUR INSTITUTE OF TECHNOLOGY, Chicago, Ill., has just published its latest catalogue which details the course of subjects taken up in the various branches of study. The book is made very interesting by the addition of a number of illustrations depicting various parts of the Armour Institute and also gives in full the faculty of officers and instructors together with the advisory board. A comprehensive introductory will give any student a good idea of the aims and practical value of this correspondence method of obtaining an education. The department of electrical engineering is comprehensive and the text-books and illustrations are aimed to be secured from the best sources. Several fac simile reproductions of students' examination papers and instructors' corrections are shown, and also a list of the graduates.

THE STANDARD POLE AND TIE COMPANY, New York city, will be forced at an early date to move into larger quarters. The space which it is able to obtain in the Edison Building, where it has been for the last three years, is so limited as to greatly inconvenience the work. During the year just closed, the company has been very successful, and has sold more poles and crossarms than in any previous year, and at the beginning of this new year finds itself in better position for handling the large business than at any previous time in its history. The new crossarm mill at Brooksville, Fla., is now in operation and the demand which has already been made for crossarms has been so great that orders have been given for a second mill, to keep pace with the times. In the North Carolina yards where the juniper poles are stored it has just installed a new system of delivery and loading which will greatly reduce the labor and expense at that point besides making it possible to load over four times the number of poles at the same time.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has just completed the largest year's business in its history and a notably large amount of the orders closed are for installations for Edison stations. The New York Edison Company has just contracted for eight new batteries of standard unit size, each having a capacity of 8,000 ampere-hours. With the thirteen installations already in service this makes twenty-one batteries of chloride accumulators, having a total capacity of 176,000 ampere-hours, operated by the New York Edison Company. This is the largest amount of storage battery operated by any one company in the world. The Chicago Edison Company has also recently added three new batteries to its system and has increased the capacity of its other batteries, making ten installations with an aggregate capacity of 108,000 ampere-hours. The Brooklyn Edison Company recently added two new batteries to the six already in service, each consisting of 8,000 ampere-hours capacity, making a total battery capacity for this company of 51,000 ampere-hours. While the volume of business closed during the year 1902 by the Electric Storage Battery Company is most gratifying to the company, the greatest satisfaction is found in the fact that these companies were among the earliest users of chloride accumulators and have since become the largest.